GALLATIN COUNTY
MONTANA

COMMUNITY
WILDFIRE
PROTECTION PLAN

MARCH 2006

Gallatin County Community Wildfire Protection Plan

Participated in and Reviewed by the Following

Amsterdam Rural Fire Dist.

Bozeman City Fire Dept.

Bridger Canyon Rural Fire Dist.

Central Valley Fire Dist.

Clarkston Fire Service Area

Fort Ellis Fire Service Area

Gallatin Canyon Consolidated Rural Fire Dist. (Big Sky)

Gallatin Gateway Rural Fire Dist.

Manhattan Rural Fire Dist.

North Side Rural Fire Dist.

Rea Fire Service Area

Rocky Mountain RC & D

Sedan Rural Fire Dist.

Sourdough Rural Fire Dist.

Springhill Fire Service Area

Three Forks Rural Fire Dist.

West Yellowstone Fire Dept.

Willow Creek Rural Fire Dist.

Gallatin County Fire

Gallatin County Commission

Gallatin National Forest

MT Department of Natural Resources and Conservation

USDI Bureau of Land Management

A special thanks to everyone that assisted and helped with the development of the Gallatin County Community Wildfire Protection Plan. With out your help this would not be a viable document, with your continued support and assistance the Gallatin County Community Wildfire protection Plan will become a useful document that all persons and agencies can benefit from.

Chris Mork
Gallatin County Fire

It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, who comes short again and again, because there is no effort without error and shortcoming; but who does actually strive to do the deeds; who knows great enthusiasms, the great devotions; who spends himself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who neither know victory nor defeat.

Theodore Roosevelt
26th President of the United States

INTRODUCTION:

After the 2000 fire season in the United Stated, it was evident to government officials, federal, state and local that something must be done to better prepare and protect communities and residents that live in or near forested lands. With hundreds of people homeless and thousands of acres of both private and public lands burned, it became evident that something must be done to better protect landowners, our natural resources and recreational forests.

In 2000 the Federal Emergency Management Agency (FEMA) began a pre-disaster program. This required every county in the nation to prepare an all-risk assessment and mitigation plan for any anticipated natural disaster (i.e. flooding, earthquake, winter storm, wildfires).

The National Fire Plan was developed in August 2000, following a landmark wildland fire season, with the intent of actively responding to severe wildland fires and their impacts to communities while ensuring sufficient firefighting capacity for the future. The NFP addresses five key points: Firefighting, Rehabilitation, Hazardous Fuels Reduction, Community Assistance, and Accountability. In Montana the Forest Service (USFS) has worked with the Montana Department of Commerce to award grants to communities for the development of community fire plans. The Bureau of Land Management (BLM) has also been a major contributor in funding at the local county level. (1)

The Healthy Forests Initiative (HFI) was launched in August, 2002 by President Bush with the intent to reduce the risks severe wildfires pose to people, communities, and the environment. By protecting forests, woodlands, shrub lands, and grasslands from unnaturally intensive and destructive fires, HFI helps improve the condition of our public lands, increases firefighter safety, and conserves landscape attributes valued by society.(2)

Compared with earlier times, many of today's forests often have unprecedented levels of flammable materials including among other materials: underbrush, needles, and leaves. In the interior West for example, Ponderosa pine forests range from Arizona and New Mexico northward into Idaho. A century ago such a forest may have had some 25 mature trees per acre and be easily traversed on horseback or by a horse-drawn wagon. Today that same forest may have more than 1,000 trees on the same acre creating conditions that are much too thick for the passage of a hiker. These tightly packed trees are smaller, weaker, more disease prone, and more susceptible to insect attack than their ancestors. Such forests form huge reservoirs of fuel awaiting ignition, and pose a particularly significant threat when drought is also a factor. (2)

The purpose of this plan is to better position fire protection agencies, government leaders, community residents, forest owners and managers to be better prepared to protect county residents, visitors and its natural resources from the potentially dangerous and devastating impacts of wildfire. It is also the purpose to promote Education of safety in the Wildland Urban Interface (WUI) along with promotion of defensible space and reasonable hazard mitigation.

The goals for this CWPP are simple and straight foreword:

- Protect life and human safety
- Prevent or limit the loss of property
- Restore and preserve our forest ecology

Objectives:

This plan has multiple but basic objectives. These objectives are as follows:

1. Identify and prioritize current WUI areas within and around each of the 19 fire districts and departments to include adjacent public lands.

2. Identify potential areas that are currently under development or in planning stages within these fire districts and fire service areas.

3. Identify local fire protection resources.

4. Provide detailed mapping of Gallatin County, fire departments, and WUI areas

5. Inform and educate public and private land owners of hazardous or potentially hazardous WUI areas.

6. Provide ideas and recommendations for possible hazard mitigation in high risk areas.

7. Continue to bring local, state, federal and interested party decision makers to the table for future planning and education.

This document and its recommendations are just that, recommendations. None of the entities within this document are formally required to support these actions, but agree that if resources and funding are secured, these actions and recommendations are worth pursuing.

This plan and its contents are intended to be an adaptive and dynamic document, one that will continue to be updated or changed annually or as needed. Changes within the county, priorities, needs, accomplishments should be reflected with in this ever changing document.

County Overview:

Located in a in the heart of the Rocky Mountains, Gallatin County is the most populated and fastest growing county in southwest Montana. The County Seat being Bozeman, at large the county encompasses over 50,000 people.

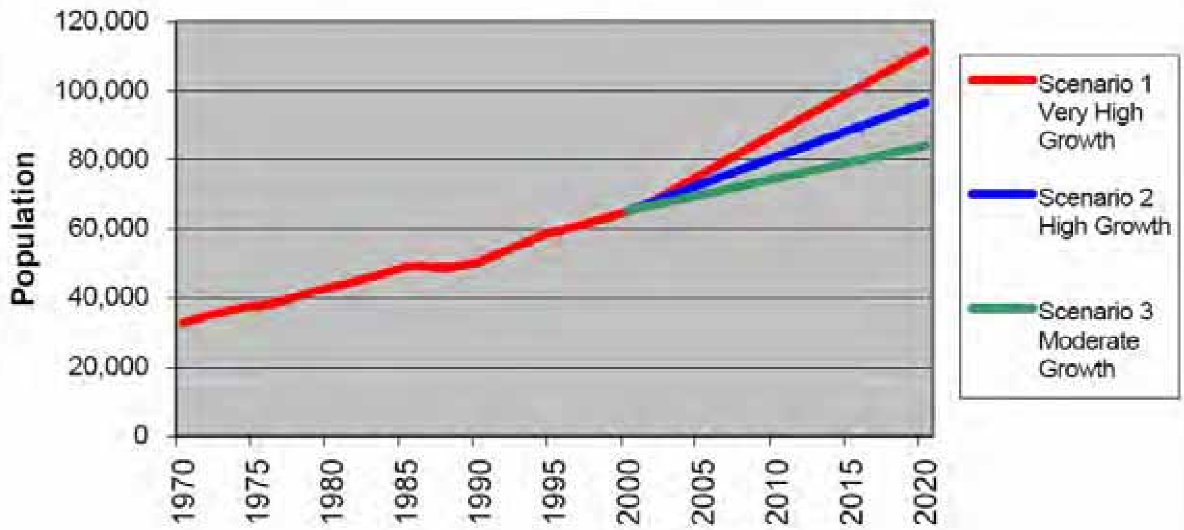
Gallatin County covers over 2,500 square miles of mountain lands varying in topography and climate from temperate river valleys to snow-capped peaks and open ranch lands. Nearly half of all the land in Gallatin County is under public ownership by the Gallatin National Forest, State of Montana, Bureau of Land Management or the National Park Service.

Gallatin County is large and diverse, featuring everything from the spectacular scenery of Yellowstone National Park (our first National Park) to lush farmland, and a growing economy of high-tech industries. Skiers, outdoor enthusiasts, wildlife watchers, mothers and fathers, business owners, vacationers, ranchers, retirees, students and many others have grown to love Gallatin County's boundless opportunities.(3)

By: Sam Gardner -- USDA Forest Service Aug 13, 2005

Gallatin County's population has grown explosively within the last decade. With a large amount of the new county residents looking to get away from the busy city life they find that Montana and the Gallatin Valley have most if not all of what they are looking for. Due too this fact many residents are finding beautiful property away from town to achieve that "Country Living". Many of these great homes and property fall within the wildland urban interface area. People want to live in the forested land or at least as close as they can get.

Figure 3-1
Gallatin County Population Trends & Projections 1970-2020



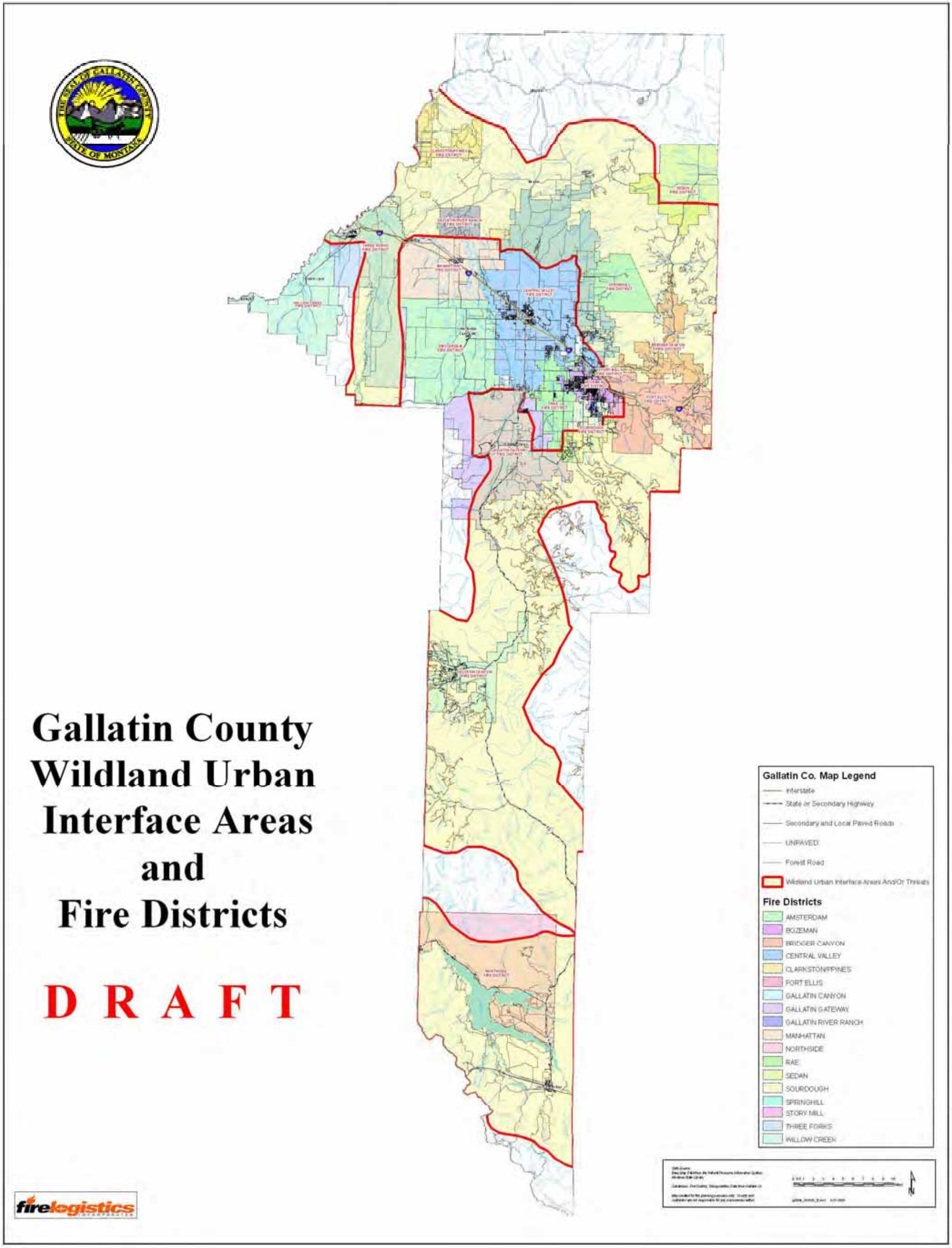
Gallatin County's population increased from 50,463 in 1990 to 67,831 in 2000 - an increase of 17,368 people. This represents an increase in population of approximately 34 percent over a ten-year period, or an average growth rate of 3.4 percent per year. The entire state of Montana grew by 12.9 percent between 1990 and 2000 (799,065 in 1990 and 902,195 in 2000) with an average growth rate of approximately 1.29 percent per year.

From 1978 to 1992, 295 square miles of farm and ranch land in Gallatin County were converted to non-agricultural production. This equals about one-fifth of the approximately 895,000 acres of privately owned lands in Gallatin County. Since January 1993, more than 17,000 acres of the land within Gallatin County have been divided for development purposes. Approximately 2,000 new parcels have been created for development since April 1993. From 1970 to 1997, the population of Gallatin County grew by 88 percent. However, since 1970, the population in the rural areas of Gallatin County has seen a 138 percent increase, while the urban population only had a 64 percent increase. (5)

With its snow-covered mountain peaks and internationally known “blue ribbon” trout streams, the Gallatin National Forest is a popular recreation area in Montana’s Northern Rockies. Established in 1899, the Gallatin is part of the Greater Yellowstone Area, the largest intact ecosystem in the continental United States. This 1.8-million acre Forest spans six mountain ranges and includes two Congressionally-designated Wilderness areas, the Absaroka-Beartooth and Lee Metcalf Wildernesses. The Gallatin National Forest provides habitat for a full complement of native fauna, including four federally listed threatened species – the grizzly bear, gray wolf, bald eagle, and the Canada lynx.. (4)

Becki Heath
Forest Supervisor

Photo: Travis Andersen


Gallatin County
Wildland Urban
Interface Areas
and
Fire Districts
D R A F T
Gallatin Co. Map Legend
Interstate
State or Secondary Highway
Secondary and Local Paved Roads
UNPAVED
Forest Road
Wildland Urban Interface Areas And/Or Threats
Fire Districts
AMSTERDAM
BOZEMAN
BRIDGER CANYON
CENTRAL VALLEY
CLARKSTON/PPINES
FORT ELLIS
GALLATIN CANYON
GALLATIN GATEWAY
GALLATIN RIVER RANCH
MANHATTAN
NORTHSIDE
RAE
SEDAN
SOURDOUGH
SPRINGHILL
STORY MILL
THREE FORKS
WILLOW CREEK
firelogistics

Fuel Models:

One can find many different types of vegetation within Gallatin County, from an assortment of wild flowers to Douglas-fir, Lodge Pole Pine timber, Cottonwood trees in and around the rivers to wheat and alf alfa fields in the valley. These are the three main fuel model types found within and around the urban interface areas of Gallatin County.

Fuel model 2: This is represented by the grass/sagebrush fuel type in the area, as well as the Douglas-fir (DF) timber type that may have more grass in the under story that carries the fire versus the conifer needles carrying the fire.

Fuel model 8: This is represented by the DF timber type which is a short-needle conifer with a more compact litter layer and denser canopy.

Fuel model 10: This is also the DF timber type in the area with dense canopy and more of an under story component such as shrubs and small trees that can create ladder fuels. FM 10 also has more dead and down large fuels which can increase fire intensity.

The following table summarizes the potential fire behavior in the three fuel types. Actual observed fire behavior could be much less or greater depending on actual conditions during a fire event. This potential fire behavior is estimated using average temperatures, wind speed, slope, and relative humidity for an average August summer day. For this table temps are estimated around 85-90 Deg F, Relative Humidity 15-20 %, Wind Speed 10-15 Mph, and moving upslope. Also assume 45% slope, fine fuel moisture 4-6% and Live fuel moisture 100%. Reference Fisher, Photo series guide, USDA Forest Service, GTR-INT-98, 1981.

Fuel Model	Rate of Spread	Flame Length
FM 2, Grass, w/over story	25-33 chains/hr	5-7 ft
FM 8, Timber, short needle	2-3 chains/hr	1-1.5 ft
FM 10, Timber, mature with under story, dead/down fuels	7-8 chains/hr	4-6 ft

Fire Ecology:

Many different species of plants and trees can be found within Gallatin County. Here are some examples of tree species and some information about how fire affects them.

Lodgepole pine (Pinus contorta var. latifolia)

Fire adaptations: Rocky Mountain lodgepole pine thrives under the influence of fire, and on many sites fire is essential to Rocky Mountain lodgepole pine dominance. In a Colorado study comparing subalpine forest stands of similar age (250 to 320 years), Rocky Mountain lodgepole pine regeneration was significantly greater ($p<0.05$) in areas that experienced surface fire than in areas where fire had not occurred. Rocky Mountain lodgepole pine comprised 41% of total species composition where surface fire was a factor, compared to 15% without fire.
Serotinous cones are an adaptation to stand-replacing fire, and the seed supply is nearly always available on the tree. No matter what season the fire occurs the seeds will reach the ground soon after, unless the cones burn. Most Rocky Mountain lodgepole pine stands are composed of trees containing both serotinous and nonserotinous cones. The ratio of serotinous to nonserotinous cones seems to be related to the fire history of the site. Other characteristics that contribute to Rocky Mountain lodgepole pine success and site dominance following fire are early seed production, prolific seed production, high seed viability, high seedling survival, and rapid growth.

Fuels: The fuel accumulation in Rocky Mountain lodgepole pine stands varies, resulting in variable fire severity. Rocky Mountain lodgepole pine has short needles and does not produce a highly combustible litter layer, and changes in fuel loading over time are affected by decomposition of material killed but not consumed by the previous fire, the fall and decay of snags, stand development, and the effects of insects and diseases. Insect infestations and disease, particularly lodgepole pine dwarf-mistletoe (*Arceuthobium americanum*), alter the quantity and spatial distribution of fuels in Rocky Mountain lodgepole pine stands, setting the stage for mixed-severity or stand-replacing fires. Fuel loads and fire hazard changes also vary according to the function of Rocky Mountain lodgepole pine in the stand: whether seral, persistent, or climax.

Fire regimes: Natural fire frequency in Rocky Mountain lodgepole pine stands ranges from a few years to 200 years. Fire intervals of 100 to 250 years are characteristic of Rocky Mountain lodgepole pine in the northern Rockies; however, mean fire intervals may be as short as 20 to 50 years in small stands. The mean fire interval in subalpine forests (Rocky Mountain lodgepole pine/subalpine fir/Engelmann spruce) of Alberta has been estimated at 90 years. In a study of fire history in the northern Rockies, it was found that fire in Rocky Mountain lodgepole pine was more frequent and less intense in areas having dry summers. Surface fires of low to medium intensity were common, especially on gentle slopes.

Minimum fire-free intervals in Jasper National Park, Alberta were 1 to 16 years; maximum fire-free intervals ranged from 31 to 88 years. Less frequent, large stand-replacing fires were prevalent in areas having moist summers. Fire intervals in Rocky Mountain lodgepole pine have changed over time; in a northern Utah study of the Rocky Mountain lodgepole pine cover type, mean fire interval during the presettlement period (1700-1855) was 39 years, with a range of 12 to 122 years. During the settlement period (1856-1909), the mean fire interval was 6 years (range 1-12 years) while no evidence was found for fires occurring in the post-settlement suppression period (1910-1988). A study in Jasper National Park examined 5 Rocky Mountain lodgepole pine forests and found mean fire return intervals of 12, 23, 25, 29, and 45 years, respectively. Rocky Mountain lodgepole pine in a mixed-severity fire regime generally experiences fire every 25 to 75 years, while fires at longer intervals (100 to 300 years) and patchy burn pattern are typical of Rocky Mountain lodgepole pine in a stand-replacement fire regime.

Douglas Fir (Pseudotsuga menziesii var. glauca):

In the pole and sapling stages Rocky Mountain Douglas-fir is susceptible to fire damage as bark is thin, photosynthetic, and resin-filled. Trees develop fire-resistant bark in about 40 years on moist sites in the northern Rockies. The thickness of the bark layers is about 12% to 13% of bole diameter in the Northern Rockies. Mature trees can survive moderately severe surface fires because the lower bole is covered by thick, corky bark that insulates the cambium from heat damage. Fire scars are characterized by resin deposits that may increase the size of the scar in subsequent fires. Rocky Mountain Douglas-fir usually forms obvious fire scars and can survive several centuries after injury, making the history of understory fire easily studied. Rocky Mountain Douglas-fir is killed by crown damage; fine twigs and buds are particularly susceptible.

Fire resistance offered by thick bark is often offset by low-growing branches which may be retained even when shaded out and no longer green. Trees that host Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) often accumulate dense brooms that increase likelihood of charring of the bole or torching.

Mature Rocky Mountain Douglas-fir is generally more fire resistant than spruces, true firs, lodgepole pine, western hemlock, western redcedar, and western white pine and slightly less fire resistant than ponderosa pine and western larch. Rocky Mountain Douglas-fir is, however, slower growing and much less fire resistant than ponderosa pine or western larch in sapling and pole stages.

High fire frequency reduces the dominance of Rocky Mountain Douglas-fir relative to western larch and ponderosa pine because of the species' differential rates of growth and susceptibility to fire. During pre-settlement times frequent fire often maintained ponderosa pine rather than Rocky Mountain Douglas-fir on drier sites, as Rocky Mountain Douglas-fir did not reach fire resistant size before the next fire. On more mesic sites western larch was dominant as its bark is more fire resistant than ponderosa pines and its deciduous habit allows it to recover from crown scorch more easily. On moist sites Rocky Mountain Douglas-fir growth is rapid enough that some reach fire-resistant size before the next fire, allowing open stands to develop. Fire suppression has allowed Rocky Mountain Douglas-fir to spread from these fire-safe sites and form extensive pole-sized stands in mountain grasslands.

Rocky Mountain Douglas-fir relies on wind-dispersed seeds to colonize burned areas where trees have been killed. Mineral soil exposed by burning provides a good seedbed. Seedling establishment begins a few years after fire and is restricted to within a few hundred yards of seed trees adjacent to the fire or relatively undamaged by the fire. On xeric sites, Rocky Mountain Douglas-fir establishment is more successful in shade. On wet sites with thick litter layers, fire can aid establishment by reducing litter layer thickness. Oswald and others observed that prescribed fire (in October) favored Rocky Mountain Douglas-fir establishment on a western redcedar/queencup beadlily habitat type by reducing the thickness of litter layers.


Aleen Kienholz – Purdy Fire 2001

Fire regimes: Fire regimes in moist Rocky Mountain Douglas-fir habitat types are mixed, ranging from low to moderate severity surface fires at relatively frequent intervals (7 to 20 years) to severe crown fires at long intervals (50 to 400 years). In some areas, large fires burn at several intensities, changing with shifts in stand structure, fuel loads, topography, and weather. The result is a mosaic of burn patterns. Intense crown fires or repeat fires generally favor seral associates such as Quaking Aspen or Rocky Mountain lodgepole pine. In the Bob Marshall Wilderness in Montana, Rocky Mountain Douglas-fir-dominated sites were converted to Rocky Mountain lodgepole pine by 3 fires at 30- to 40-year intervals. Another site in the same area was converted from a Rocky Mountain Douglas-fir-western larch forest to a forest dominated by Rocky Mountain lodgepole pine as a result of a single severe fire.

Subalpine (Abies lasiocarpa):

Subalpine fir is very fire sensitive and generally suffers high mortality even from low intensity fires. It relies on wind-dispersed seeds which readily germinate on fire-prepared seedbeds to colonize burned areas. The occasional mature tree which survives fire, those escaping fire in small, unburned pockets, and trees adjacent to burned areas provide seeds to colonize burned sites. In subalpine habitats, scattered subalpine fir trees often escape fire because of discontinuous fuels, broken and rocky terrain, and the moist and cool environment.

Fire regime: Subalpine fir habitat types vary from cold and wet at higher elevations to warm and moist or cool and dry at lower elevations. This environmental gradient influences the mean fire return interval (MFRI). Relatively dry lower elevation subalpine fir habitat types have more frequent and less intense fires than moist middle and upper elevation subalpine fir habitat types. Such forests in the Bitterroot National Forest in Montana have a MFRI of 17 to 28 years. Fires at this frequency kill subalpine fir and keep these forests dominated by seral conifers such as lodgepole pine, Douglas-fir, or western larch. Moist, middle and upper elevation subalpine fir habitat types, however, generally experience high intensity stand-replacing fires at intervals of 100 years or more.

Fuels and fire behavior: The fuel structure in subalpine-fir-dominated stands promotes highly destructive stand-destroying fires. Fuel loads in subalpine fir stands are greater than in lower elevation montane stands because the cool and moist environment slows the decomposition of organic matter allowing fuels to accumulate more rapidly. Fuel beds tend to be irregular, with over twice as much fuel accumulating under the narrow-crowned trees as between them. The needles are small and fine and form a compact fuel bed in which fire spreads slowly. These concentrated, slow burning fuels frequently produce flames high enough to reach subalpine fir's low-growing dead branches. Thus crowning is common in subalpine fir stands.

Once a crown fire begins, it spreads easily because subalpine fir has a tendency to grow in dense stands and has highly flammable foliage. A lightning strike on May 7, 1987, in a subalpine fir-mountain hemlock stand in Mount Rainier National Park started a crown fire even though the ground was still partially snow covered. The fire spread slowly through the tree crowns by (1) igniting lichens draped along the fine branches, (2) preheating and igniting the foliage, and (3) spreading to a nearby tree by igniting its lichens.

Current Hazards/Problems:

Gallatin County currently has a few very unique problems facing it. As more and more people move into the county less and less rural property is being used for agriculture and recreation and more land is being developed for residential and commercial property use. As this trend continues to grow, more and more people are moving into the Urban Interface area.

With the typical fire history and the use of fire in our national forests, including the Gallatin National Forest, the timber and other forest products have been allowed to grow dense and thick. For more than 100 years, forest and wildland fires have been suppressed, not allowing the proverbial "Mother Nature" to take care of herself. Along with the reduction of logging and increased environmentalist action our national forests have changed from almost city park like to having thick mature and over mature tree stands with tons of downed and dead timber and understory laying on the ground.

With such current fire suppression policies in place, fire has not been allowed to take its natural role in maintaining forest health. This in part is a large reason today we see such massive and intense stand replacing fires within our national forests. In both Yellowstone National Park and the Gallatin National Forest areas naturally ignited by fire may still be allowed to burn, under certain conditions, to meet specific resource management objectives. Prescribed fire is another tool that is utilized by these agencies as well as some land owners here in Gallatin County.

With a new century many ideas and thoughts have changed and a new outlook on how our national forests and public land should be managed is being developed. The use of fire and progressive forest reclamation and management are heavily being implemented within and around our national forests and public property, including our Gallatin National Forest. Some private land owners have been successfully managing their forested property for some time now and it shows how a well maintained forest can be beneficial not only to humans, but to all that inhabit the forested lands.

Due too recent large fires and the increase of building in the forested areas it has become evident that something must be done to better protect our communities while preserving our native ecosystem. In many instances home owners and builders give very little consideration or thought to where and how they build their homes. Many homes and communities have been lost in wildland fires across the nation. Not only homes have been lost, but also firefighters loose their lives each year protecting these homes and properties.

Preventing DISASTER

Home Ignitability in the Wildland–Urban Interface

Wildland-urban interface (W-UI) fires are a significant concern for federal, state, and local land management and fire agencies. Research using modeling, experiments, and W-UI case studies indicates that home ignitability during wildland fires depends on the characteristics of the home and its immediate surroundings. These findings have implications for hazard assessment and risk mapping, effective mitigations, and identification of appropriate responsibility for reducing the potential far home lass caused by W-UI fires,

By Jack D. Cohen

Once largely considered a California problem, residential fire losses associated with wildland fires gained national attention in 1985 when 1,400 homes were destroyed nationwide (Laughlin and Page 1987). The wildland fire threat to homes is increasing and is commonly referred to as the wildland—urban interface (W-UI) fire problem. Since 1990, W-UI fires have threatened and destroyed homes in Alaska, Arizona, California, Colorado, Florida, Michigan, New Mexico, New York, and Washington. Extensive or severe fires in Yellowstone in 1988, Oakland in 1991, and Florida in 1998 attracted much media coverage and focused national attention on wildland fire threats to people and property

Federal, state, and local land management and fire agencies must directly and indirectly protect homes from wildfire within and adjacent to wildlands. Davis (1990) indicated that since the mid-1940s, a major population increase has occurred in or adjacent to forests and woodland areas. Increasing residential presence near fire-prone wildlands has prompted agencies to take actions to reduce W-UI fire losses.

When an apparently all-encompassing, seemingly unstoppable W-UI fire occurs, the rapid involvement of many homes over a wide area produces a surreal impression; some homes survive amid the complete destruction of surrounding residences. After the 1993 Laguna Hills fire, some termed this seemingly inexplicable juxtaposition a “miracle.’ Miracles aside, the characteristics of the surviving home and its immediate surroundings greatly influenced its survival.

Wildland fire and home ignition research indicates that a home’s exterior and site characteristics significantly influence its ignitability and thus its chances for survival. Considering home and site characteristics when designing, building, siting, and maintaining a home can reduce W-UI fire losses.

W-UI Fire Loss Characteristics

W-UI residential fire losses differ from typical residential fire losses. Whereas residential fires usually involve one structure with a partial loss, W-UI fires can result in hundreds of totally destroyed homes. Particularly during severe W-UI fires, numerous

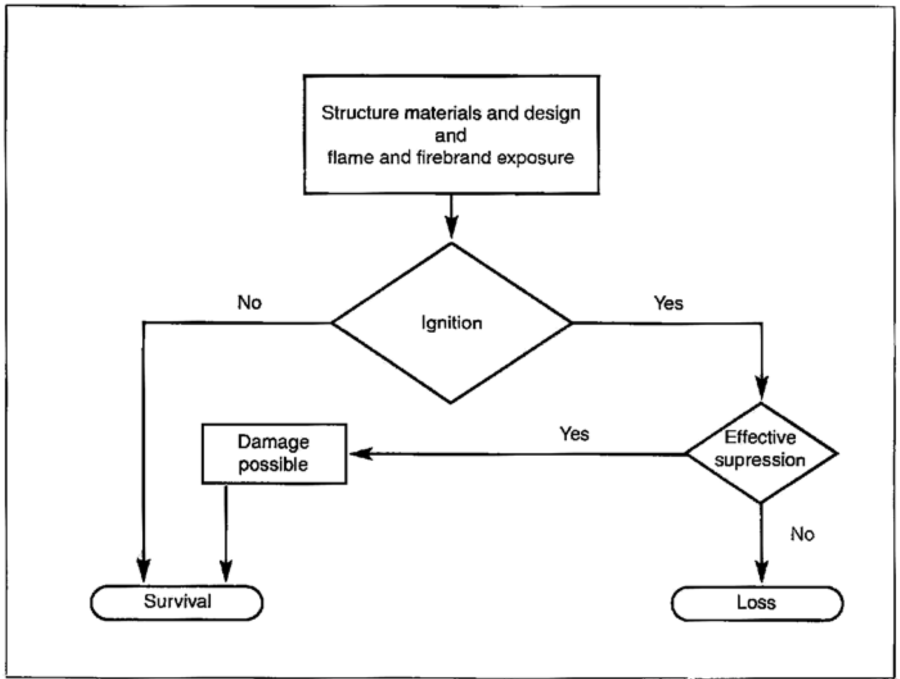


***Figure 1*. The structure survival process**

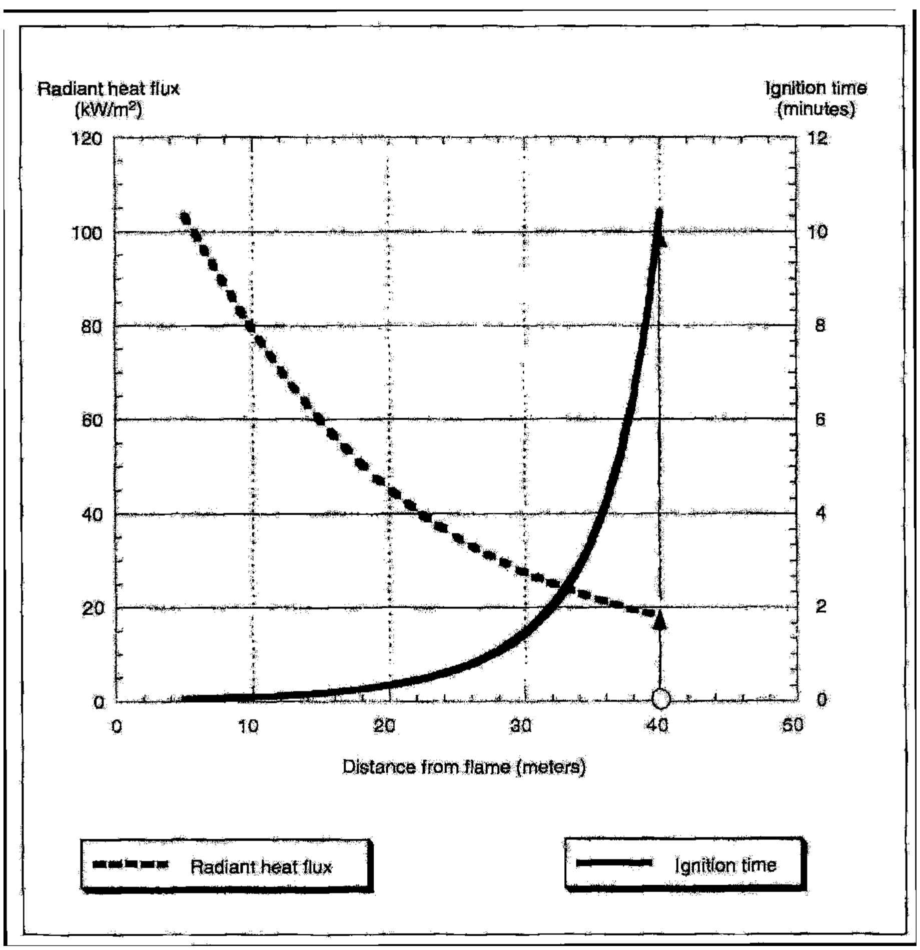


***Figure* 2.The incident radiant heat flux is shown as a function of a wall's distance from a flame 20 meters high by 50 meters wide, uniform, constant, 1,200 K, black-body. The minimum time required for a piloted wood ignition is shown given the corresponding heat flux at that distance.**

homes can ignite in a very short time. The usual result is that a home either survives or is totally destroyed; only a few structures incur partial damage (Foote 1994).

The W-UI Fire commonly originates in wildland fuels. During dry, windy conditions in areas with continuous fine fuels, a wildland fire can spread rapidly, outpacing the initial attack of firefighters. If residences arc nearby, a wildland fire can expose numerous homes to flames and lofted burning embers, or firebrands.

A rapidly spreading wildland fire coupled with highly ignitable homes can cause many homes to burn simul-taneously. This multistructure involvement can overwhelm fire protection Capabilities and, in effect, result in unprotected residences. Severe W-UI fires can destroy whole neighborhoods in a few hours—much faster than the response time and suppression capabilities of even the best—equipped and staffed firefighting agencies. For example, 479 homes were destroyed during the 1990 Painted Cave fire in Santa Barbara, most of them within two hours of the initial fire report. The 1993 Laguna Hills fire in southern California ignited and burned nearly all of the 366 homes destroyed in less than five hours.

Whether a home survives depends initially on whether it ignites; if ignitions with continued burning occur, survival then depends on effective fire suppression. *Figure 1* shows that home survival begins with attention to the factors that influence ignition. These factors determine home ignitability and include the structure's exterior materials and design combined with its exposure to flames and firebrands. The lower the home ignitability the lower the chance of incurring an effective ignition.

Ignition: A local Process

Ignition and spread of fire, whether on structures or in wildland vegetation, is a combustion process. Fire spreads as a continuing ignition process whether from the propagation of flames or from the spot ignitions of firebrands. Unlike a flash flood or an avalanche, in which a mass engulfs objects in its path, fire spreads because the requirements for combustion are satisfied at locations along the path. The basic requirements for combustion—the fire triangle—are fuel, heat, and oxygen. An insufficiency of any one of the three components, which can occur over a relatively short distance, will prevent a specific location from burning. "Green islands" that remain after the passage of a severe, stand-replacement fire demonstrate this phenomenon. Commonly one can find a green, living tree canopy very close to a completely consumed canopy.

The requirements for combustion equally apply to the W-UI fire situation. In the wildland fire context, fire managers commonly refer to vegetation as fuel. However, for the specific context of W-UI residential fire losses, a house becomes the fuel. Heat is supplied by the flames of adjacent burning materials that could include firewood piles, dead and live vegetation, and neighboring structures. Firebrands from upwind fires also supply heat when they collect on a house and adjacent flammable materials. The atmosphere amply supplies the third necessary component, oxygen.

A wildland fire cannot spread to homes unless the homes and their adjacent surroundings meet those combustion requirements. The home ignitability determines whether these requirements are met, regardless of how intensely or fast—spreading distant fires are burning. To use an extreme example, a concrete bunker would not ignite during any wildland fire situation. At the other extreme, some highly ignitable homes have ignited without flames having spread to them. These homes directly ignited from firebrands.

Firebrands are a significant ignition source during W-UI fires, particularly when flammable roofs are involved. Foote (1994) found a significant difference in home survival solely based on roof f1ammability. Homes with nonflammable roofs had a 70 percent survival rate compared with 19 percent for homes with flammable roofs. Davis (1990) reported similar results related to roof flammability.

Reducing W-UI fire losses in the context of home ignitability involves mitigating the fuel and heat components sufficiently to prevent ignitions. However, the question of sufficiency (or efficiency) remains: How much, or perhaps more appropriately, how little fuel and heat reduction must be done to effectively reduce home ignitions? To answer this question, we must first quantify the heat source in terms of the fuel's ignition requirements; specifically, how close can flames be to a home's wood exterior before an ignition occurs?

Research Insights

Diverse research approaches are providing clues for assessing the fuel and heat requirements for residential ignitions. Structure ignition modeling, fire experiments, and W-UI fire case studies indicate that the fuel and heat required for home ignitions only involve the structure and its immediate surroundings—the home ignitability context.

Modeling. The Structure Ignition Assessment Model (SIAM) (Cohen 1995) is currently being developed to asses the potential for structure ignitions from flame exposure and firebrands during W-UI fires. One function of SIAM is to calculate the total heat transferred, both radiation and convection, to a structure for varying flame sizes and from varying distances. From the calculated heat transfer, SIAM calculates the amount of heat over time that common exterior wood products can sustain before the occurrence of a piloted ignition (Tran et al. 1992).

Piloted ignition When wood is sufficiently heated, it decomposes to release combustible volatiles. At a sufficient volatile—air mixture, a small flame or hot spark can ignite it to produce flaming; thus, a piloted ignition.

Based on severe-case assumptions of flame radiation and exposure time, SIAM calculations indicate that wildland flame fronts comparable to crowning and torching trees (flames 20 meters high and 50 meters wide) will not ignite wood surfaces at distances greater than 40 meters (Cohen and Butler, in press). *Figure 2* shows the radiant heat a wall would receive from flames depending on its distance from the fire. The incident radiant heat flux, defined as the rate of radiant energy per unit area received at an exposed surface, decreases as the distance increases.

Figure 2 also shows that the time required for ignition depends on the distance to a flame of a given size. At 40 meters the radiant heat transfer is less than 20 kilowatts per square meter *(kW/m²),* which translates to a minimum piloted ignition time of more than 10 minutes.

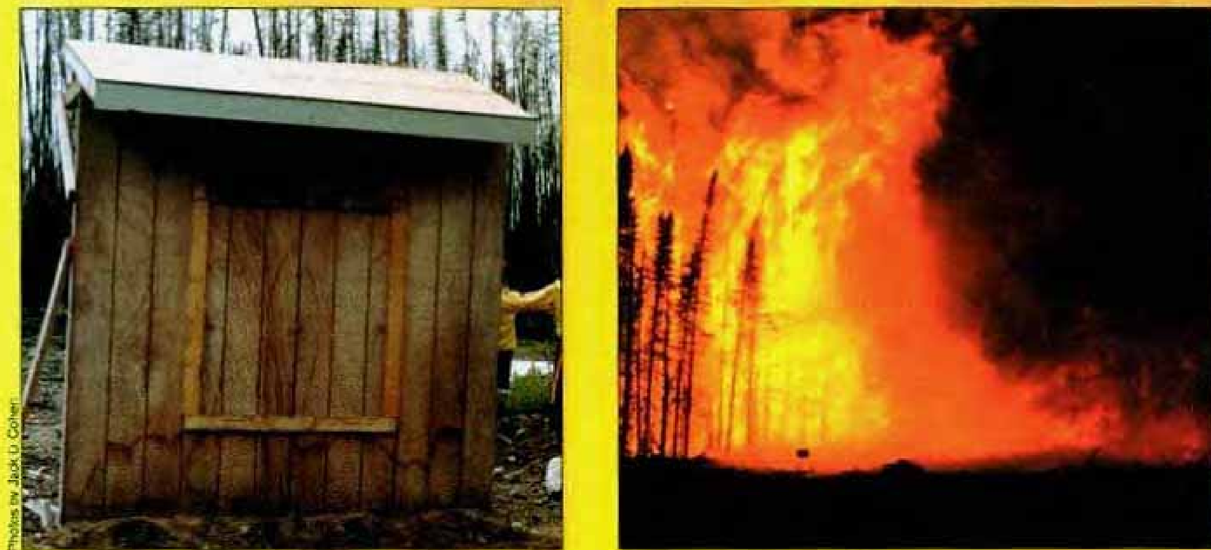
1 kW/m²	Maximum for indefinite skin exposure.
10.4 kW/m²	Pain after three seconds of skin exposure.
16.0 kW/m²	Second-degree burn after five seconds of skin exposure.

Source: Drysdale 1985.

Ten minutes, however, is significantly longer than the burning time of wildland flame fronts at a location. Large flames of wildland fires typically depend on fine dead and live vegetation, which limits the intense burning duration at a specific location to less than a few minutes. Recent crown fire experiments have demonstrated a location-specific burning duration of 50 to 70 seconds.

Experiments. Field studies conducted during the International Crown Fire Modelling Experiment (Alexander et al. 1998) provide data for comparisons with SIAM model estimates. Total heat transfer (radiation and convection) and ignition data were obtained from heat flux sensors placed in wooden wall sections.

The instrumented walls were located on flat, cleared terrain at 10, 20, and 30 meters downwind from the edge of the forested plots. The wall section at 10 meters was 2.44 meters wide and 2.44 meters high with a 1.22-meter eave and roof section (*fig. 3a).* Exterior plywood (T-1-11) covered the wall with oriented-strand board covering the roof section and the eave soffit. Trim boards were solid wood with wood fiber composition board on the cave fascia. None of the materials were treated with fire retardant.



(a) 10-meter wood wall section before the crown fire.

(b) Experimental crown fire.

Figure 3. International Crown Fire Modelling Experiment.

The forest was variably composed of an overstory of jack pine *(Pinus banksiana)* about 14 meters high with an understory of black spruce *(Picea mariana).* The spreading crown fire produced flames approximately 20 meters high. *Figures 3b and 3c* show examples of the experimental crown fire.

Five burns were conducted where wall sections were exposed to a spreading crown fire. As the crown fires reached the downwind edge of the plot, turbulent flames extended into the clearing beyond the forest edge. In two of the five burns, flames extended beyond 10 meters to make contact with the 10-meter wall section. When flame contact occurred, the 10-meter walls ignited; however, without flame contact, only scorch occurred, as shown in *figure 3d.* The wooden panels at 20 meters experienced light scorch when flames extended beyond 10 meters from the experimental plot, and no scorch from the other burns. The 30-meter wall section had no scorch from any of the crown fires.

Figure 4 displays the average total incident heat flux (radiation and convection combined) corresponding to the wall at 10 meters *(fig. 3d)* and the crown fire shown in figures *3b and 3c.* The average total incident heat flux is calculated from two sensors placed 1 meter apart in the wall. The amount of heat received by the wall increased as the flame front approached and decreased as the fine vegetation was consumed. The initial heat flux "spike" was caused by a nonuniform crowning flame front.

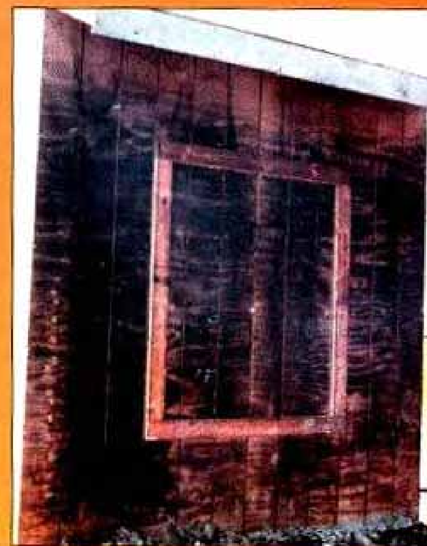
The flux-time integral shown in *figure 4* indicates whether sufficient heating has occurred to pilot-ignite wood (Tran et al. 992). SIAM uses the flux-time integral for calculating ignition potential, a correlation of the incident heat flux and the time required for piloted wood ignition.

The flux-time correlation identifies two principal ignition criteria: (1) A minimum heat flux of 13 kW/m^2 must occur before a piloted ignition can occur for any exposure time, and (2) piloted ignition depends on attaining a critical heating dosage level (heat transfer and its duration). These criteria are graphed in *figure 4.* The flux-time integral only increases for incident heat fluxes greater than the minimum of 13 kW/m^2, and the flux-time integral threshold value of 11,500 is shown as the ignition threshold. As seen in the figure, the flux-time integral does not reach the ignition threshold, indicating an exposure insufficient for ignition and corresponding to no actual occurrence of a wall ignition. Therefore, a home at some distance from a large flame front, such as a crown fire, may not receive sufficient energy to meet the minimum for ignition over any time period. In addition, a home closer to a large flame front can receive a high heat flux (for example, 46 kW/m^2 as shown in *figure 4*), but without the necessary duration to meet the threshold for ignition.

The flux-time integral plot indicates the duration of the heat transfer relevant to ignition. The heat transfer duration relevant to ignition combines the heat transfer from the approaching crown fire plus the burning time of the fire after it has reached the end of the plot. The observed time required for the flux-time integral to increase from zero to its maximum value corresponds to the heat transfer duration significant for ignition. *Figure 4* indicates a duration of 65 seconds (flux-time plot from 75 seconds to 140 seconds).

Case studies. Case studies of actual W-UI fires provide an independent comparison with SIAM and the crown

(c) Experimental crown fire.



(d) After crown fire exposure the wall scorched but did not ignite. Note the lack of wall scorch under the eave because of the radiation "shading" from the eave.

fire experiments. The actual fires incorporate a wide range of fire exposures. The case studies chosen examine significant factors related to home survival for two fires that destroyed hundreds of structures. The Bel Air fire resulted in 484 homes destroyed (Howard et al. 1973) and the Painted Cave fire destroyed 479 homes (Foote 1994).

Analyses of both fires indicate that home ignitions depend on the characteristics of a structure and its immediate surroundings. Howard et al. (1973) observed 86 percent survival for homes with nonflammable roofs and a clearance of 10 meters or more.

Dicussion

A comparison of the SIAM model calculations in *figure 2* with the observed heat flux from the experimental crown fire in *figure 4* indicated that the model overestimates the heat flux. The model calculation at 10 meters reveals a radiant heat flux of 70 kW/m^2, which exceeds the highest total heat flux of 46 kW/m^2 observed

At the 10-meter wall section in *figure 4*. SIAM calculations

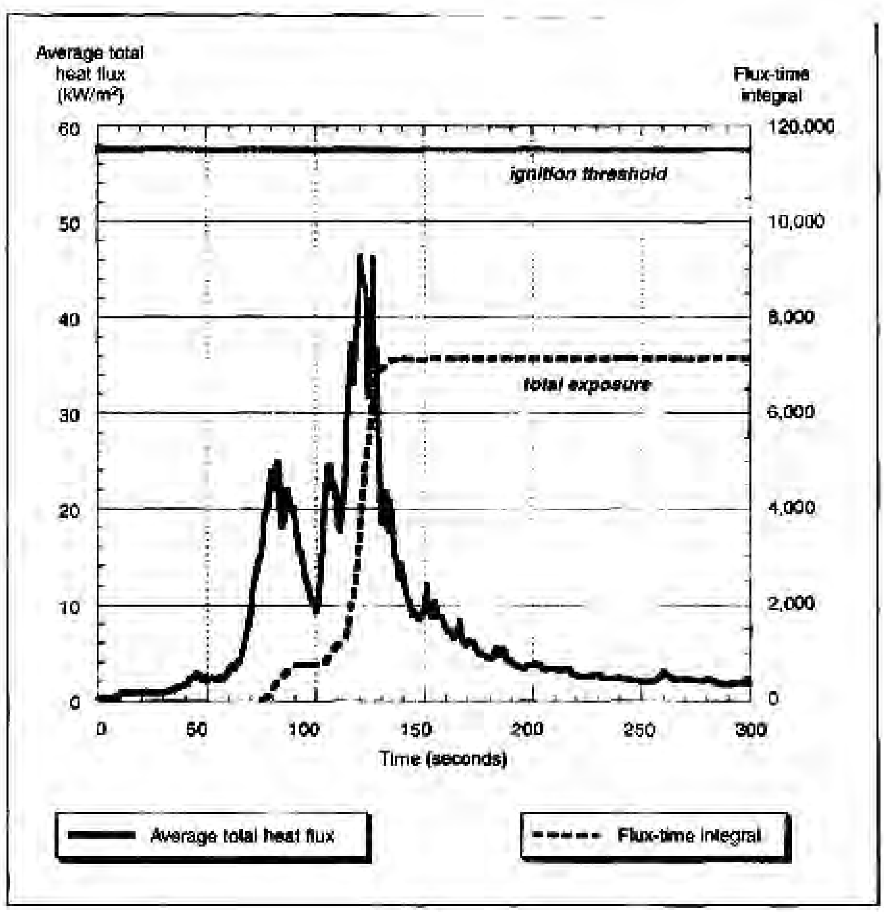


Figure 4. Actual average total incident heat flux and flux-time integral for the crown fire and 10-meter wall section shown in figure 3.

overestimate the heat transfer because the severe-case assumptions designate a homogeneous, black-body radiating flame front. Real flame fronts do not meet these assumptions and produce a significantly smaller radiant heat flux by comparison. For a given flame front, the SIAM calculations represent an extreme-case estimate of radiant heat transfer, and thus an extreme-case estimate of ignition potential.

Given the duration of the experimental heat flux (65 seconds), we can calculate the heat flux and corresponding distance required for ignition. At 65 seconds, the ignition time graph (*fig. 2)* indicates ignition at a flame distance of less than 30 meters. If the heat flux duration is extended by a factor of five to 325 seconds, the flame distance for ignition is less than 40 meters. By comparison, the 10-meter wall sections in the crown fire experiment did not ignite without flame contact and all burns produced little or no scorch to wall sections at 20 and 30 meters. The W-UI fire case studies indicated approximately 90 percent survival with a vegetation clearance on the order of 10 to 20 meters for homes with nonflammable roofs. Thus, the case studies support the general flame-to-structure distance range of 10 to 40 meters as found through modeling and experiments.

However, firebrands can also cause homes to ignite during wildland fires. Although firebrands capable of ignition can originate from a fire several kilometers away, homes can only be threatened if the firebrands ignite the home directly or ignite adjacent flammable materials that then ignite the home.

Analyses of potential home ignitions using modeling, experiments, and case studies did not explicitly address firebrand ignitions. However, firebrand ignitions were implicitly considered because of the firebrand exposures that occurred during the crown fire experiments and the case studies. The experimental crown fires provided a firebrand exposure that resulted in spot ignitions in the dead wood and duff around the wall sections hut not directly on the walls. In the case studies, firebrand ignitions occurred throughout the areas affected by the Bel Air and Painted Cave fires. The high survival rate for homes with nonflammable roofs and 10- to 20-meter vegetation clearances included fire-brands as an ignition factor, thus indicating that firebrand ignitions also depend on the ignition characteristics of the home and the adjacent flammable materials.

Conclusions

The key to reducing W-UI home fire losses is to reduce home ignitability. SIAM modeling, crown fire experiments, and case studies indicate that a home's structural characteristics and its immediate surroundings determine a home's ignition potential in a W-UI fire. Using the model results as guidance with the concurrence of experiments and case studies, we can conclude that home ignitions are nor likely unless flames and firebrand ignitions occur within 40 meters of the structure. This finding indicates that the spatial scale determining home ignitions corresponds more to specific home and community sites than to the landscape scales of wildland fire management. Thus, the W-UI fire loss problem primarily depends on the home and its immediate site.

Consequently if the community or borne site is not considered in reducing W-UI fire losses, extensive wildland fuel reduction will be required. For highly ignitable homes, effective wildland fire actions must riot only prevent fires from burning to home sites, but also eliminate firebrands that would ignite the home and adjacent flammable materials. To eliminate firebrands, wildland fuel reductions would have to prevent firebrand production from wildland fires for a distance of several kilometers away from homes.

Management Implications

Because home ignitability is limited to a home and its immediate surroundings, fire managers can separate the W-UI structure fire loss problem from other landscape-scale fire management issues. The home and its surrounding 40 meters determine home ignitability, home ignitions depend on home ignitability, and fire losses depend on home ignitions. Thus, the W-UI fire loss problem can be defined as a home ignitability issue largely independent of wildland fuel management issues. This conclusion has significant implications for the actions and responsibilities of homeowners and fire agencies, such as defining and locating potential W-UI fire problems (for example, hazard assessment and mapping), identifying appropriate mitigating actions, and determining who must take responsibility for home ignitability

W-UI fire loss potential. Because home ignitions depend on home ignitability, the behavior of wildland fires beyond the home or community site does not necessarily correspond to W-UI home fire loss potential. Homes with low ignitability can survive high-intensity wildland fires, whereas highly ignitable homes can be destroyed during lower-intensity fires.

This conclusion has implications for identifying and mapping W-UI fire problem areas. Applying the term wildland-urban interface to fire losses might suggest that residential fire threat occurs according to a geographic location. In fact, the wildland fire threat to homes is not a function of *where* it happens related to wildlands, but rather to *how* it happens in terms of home ignitability. Therefore, to reliably map the potential for home losses during wildland fires, home ignitability must be the principal mapping characteristic. The home threat information must correspond to the home ignitability spatial scale, that is, those characteristics of a home and its adjacent she within 40 meters.

Home fire loss mitigation. W-UI home losses can be reduced by focusing efforts on homes and their immediate surroundings. At higher densities where neighboring homes may occupy the immediate surroundings, loss reductions may necessarily involve a community. If homes have a sufficiently low home ignitability, a community exposed to a severe wildfire can survive without major fire destruction. Thus, there is a need to examine the reduction of wildland fuel hazard for the specific objective of home protection. There are various land management reasons for conducting wildland vegetation management. However, when considering the use of wildland fuel hazard reduction specifically for protecting homes, an analysis specific to home ignitability should determine the treatment effectiveness.

Responsibility for home ignitability. If no wildfires or prescribed fires occurred, the wildland fire threat to residential development would not exist. However, our understanding of the fire ecology for most of North America indicates that fire exclusion is neither possible nor desirable. Therefore, homeowners who live in and adjacent to the wildland fire environment most take primary responsibility for ensuring that their homes have sufficiently low home ignitability. Homes should not be considered simply as potential victims of wildland fire, but also as potential participants in the continuation of the fire at their location.

A change needs to take place in the relationship between homeowners and the fire services. Instead of home-related presuppression and fire protection responsibilities residing solely with fire agencies, homeowners must take the principal responsibility for ensuring adequately low home ignitability.

The fire services should become a community partner providing homeowners with technical assistance as well as fire response in a strategy of assisted and managed community self-sufficiency (Cohen and Saveland 1997). For this approach to succeed, it must be shared and implemented equally by homeowners and the fire services.

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Reducing the Wildland Fire Threat to Homes: Where and How Much?[1]

Jack D. Cohen[2]

Abstract

Understanding how ignitions occur is critical for effectively mitigating home fire losses during wildland fires. The threat of life and property losses during wildland fires is a significant issue for Federal, State, and local agencies that have responsibilities involving homes within and adjacent to wildlands. Agencies have shifted attention to communities adjacent to wildlands through pre-suppression and suppression activities. Research for the Structure Ignition Assessment Model (SIAM) that includes modeling, experiments, and case studies indicates that effective residential fire loss mitigation must focus on the home and its immediate surroundings. This has significant implications far agency policy and specific activities such as hazard mapping and fuel management.

The threat of life and property losses during wildland fires is a significant issue for Federal, State, and local fire and planning agencies who must consider residential development within and adjacent to wildlands. The 1995 USDA Forest Service *Strategic Assessment of Fire Management* (USDA Forest Service 1995) lists five principal fire management issues. One of those issues is the "loss of lives, property, and resources associated with fire in the wildland/urban interface" (p. 3). The report further identifies "the management of fire and fuels in the wildland/urban interface" as a topic for further assessment. Because this is more than a Forest Service issue, the National Wildland/Urban Interface Fire Protection Program, a multi-agency endeavor, has been established for over a decade and is sponsored by the Department of Interior land management agencies, the USDA Forest Service, the National Association of State Foresters, and the National Fire Protection Association. This program also has an advisory committee associated with the multi-agency National Wildfire Coordinating Group. These examples indicate that the wildland fire threat to homes significantly influences fire management policies and suggests that this issue has significant economic impacts through management activities, direct property losses, and associated tort claims.

The wildland fire threat to homes is commonly termed the wildland-urban interface (W-UI) fire problem. This and similar terms (e.g., wildland-urban intermix) refer to an area or location where a wildland fire can potentially ignite Homes. A senior physicist at the Stanford Research Institute, C.P. Butler (1974), coined the term "urban-wildland interface" and described this fire problem:

> In its simplest terms, the fire interface is any point where the fuel feeding a wildfire changes from natural (wildland) fuel to man-made (urban) fuel. …For this to happen, wildland fire must be close enough for its flying brands or flames to contact the flammable parts of the structure (p. 3).

In his definition, Butler provides important references to the characteristics of this problem. He identifies homes ("urban") as potential fuel and indicates that the distance between the wildland fire and the home ("close enough") is an important factor for structure ignition. How close the fire is to a home relates to how much heat the structure will receive.

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[1] An abbreviated version of this paper was presented at the Symposium on Fire Economics, Policy, and Planning: Bottom Lines, April 5-9, 1999, San Diego, California.

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These two factors, the homes and fire proximity, represent the fuel and heat "sides" of the fire triangle, respectively. The fire triangle—fuel, heat, and oxygen— represents the critical factors for combustion. Fires burn and ignitions occur only if a sufficient supply of each factor is present. By characterizing the home as fuel and the heat from flames and firebrands, we can describe a home's ignitability. An understanding of home ignitability provides a basis for reducing potential W-UI fire losses in a more effective and efficient manner than current approaches.

Ignition and Fire Spread are a Local Process

Fire spreads as a continually propagating process, not as a moving mass. Unlike a flash flood or an avalanche where a mass engulfs objects in its path, fire spreads because the locations along the path meet the requirements for combustion. For example, C.P. Butler (1974) provides an account from 1848 by Henry Lewis about pioneers being caught on the Great Plains during a fire:

> When the emigrants are surprised by a prairie fire, they mow down the grass on a patch of land large enough for the wagon, horse, etc., to stand on. They then pile up the grass and light it. The same wind, which is sweeping the original fire toward them, now drives the second fire away from them. Thus, although they are surrounded by a sea of flames, they are relatively safe. Where the grass is cut, the fire has no fuel and goes no further. In this way, experienced people may escape a terrible fate (p. 1-2).

It is important to note that the complete success of this technique also relies on their wagons and other goods not igniting and burning from firebrands. This account describes a situation that has similarities with the W-UI fire problem.

A wildland fire does not spread to homes unless the homes meet the fuel and heat requirements sufficient for ignition and continued combustion. In the prairie fire situation, sufficient fuel was removed (by their escape fire) adjacent to the wagons to prevent burning (and injury) and the wagons were ignition resistant enough to not ignite and burn from firebrands. Similarly, the flammables adjacent to a home can be managed with the home's materials and design chosen to minimize potential firebrand ignitions. This can occur regardless of how intensely or fast spreading other fires are burning. Reducing W-UI fire losses must involve a reduction in the flammability of the home (fuel) in relation to its potential severe-case exposure from flames and firebrands (heat). The essential question remains as to how much reduction in flammables (e.g., how much vegetative fuel clearance) must be done relative to the home fuel characteristics to significantly reduce the potential home losses associated with wildland fires.

Insights for Reducing Ignitions from Flames

Recent research provides insights for determining the vegetation clearance required for reducing home ignitions. Structure ignition modeling, fire experiments, and W-UI fire case studies provide a consistent indication of the fuel and heat required for home ignitions.

The Structure Ignition Assessment Model (SIAM) (Cohen 1995) assesses the potential ignitability of a structure related to the W-UI fire context. SIAM calculates the amount of heat transferred to a structure from a flame source on the basis of the flame characteristics and the flame distance from a structure. Then, given this thermal exposure, SIAM calculates the amount of time required for the occurrence of wood ignition and flaming (Tran and others 1992). On the basis of severe-case assumptions of flame radiation and exposure time, SIAM calculations indicate that large wildland flame fronts (e.g., forest crown fires) will not ignite wood surfaces (e.g., the typical variety of exterior wood walls) at distances greater than 40 meters (Cohen and Butler [In press]). For example, the incident radiant heat flux, the amount of radiant heat a wall would receive from flames, depends on its distance from the fire. That is, the rate of radiant energy per unit wall area decreases as the distance increases (*fig. 1,)*. In addition, the time required for a wood wall to ignite depends on its distance from a flame front of the given height and width (*fig. 1)*. But the flame's burning time compared to the required ignition time is important. If at some distance the fire front produces a heat flux sufficient to ignite a wood wall, but the flaming duration is less than that required for ignition, then ignition will not occur. At a distance of 40 meters, the radiant heat flux is less than 20 kilowatts per square meter, which corresponds to a minimum ignition time of greater than 10 minutes (*fig. 1*). Crown fire experiments in forests and shrublands indicate that the burning duration of these large flames is on the order of 1 minute at a specific location.[3] This is because these wildland fires depend on the rapid consumption of the fine dead and live vegetation (e.g., forest crown fires).

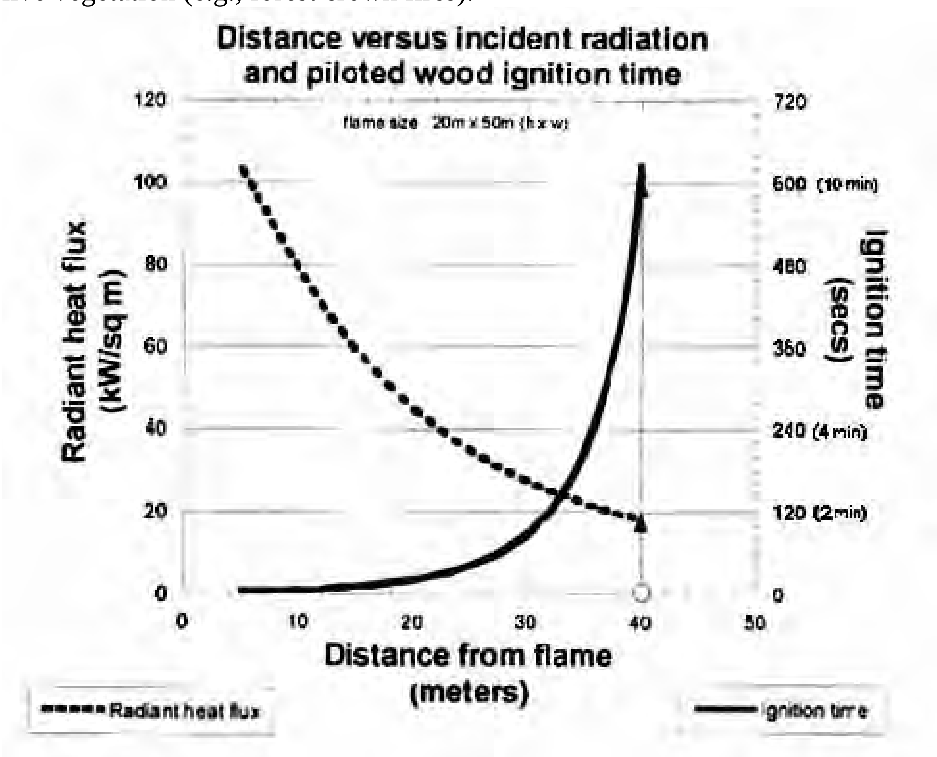

Figure 1
SIAM calculates the incident radiant heat flux (energy/unit-area/time reaching a surface) and the minimum time for piloted ignition (ignition with a small ignition flame or spark) as a function of distance for the given flame size. The flame is assumed to be a uniform, parallel plane, black body emitter.

Experimental fire studies associated with the International Crown Fire Modeling Experiment (Alexander and others 1998) generally concur with the SIAM calculations. Data were obtained from instrumented wall sections that were placed 10 meters from the forest edge of the crown fire burn plots. Comparisons between SIAM calculations and the observed heat flux data indicate that SIAM overestimates the amount of heat received.[4] For example, the SIAM calculated potential radiant heat flux for an experimental crown fire was 69 kW/ sq meter as compared to the measured maximum of 46 kW/sq meter. This is expected since SIAM assumes a uniform and constant heat source and flames are not uniform and constant. Thus, the SIAM calculations for an actual flame front represent a severe-case estimate of the heat received and the potential for ignition. The SIAM distances represent an upper estimate of the separation required to prevent flame ignitions (*fig. 1)*.

Past fire case studies also generally concur with SIAM estimates and the crown fire observations. Analyses of southern California home losses done by the Stanford Research Institute for the 1961 Belair-Brentwood Fire (Howard and others 1973) and by the University of California, Berkeley, for the 1990 Painted Cave Fire (Foote and Gilless 1996) are consistent with SIAM estimates and the experimental crown fire data. Given nonflammable roofs, Stanford Research

[3] Unpublished data on file, Rocky Mountain Research Station, Fire Sciences Laboratory) Missoula, Montana.

[4] Unpublished data on file, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

Institute (Howard and others 1973) found a 95 percent survival with a clearance of 10 to 18 meters, and Foote and Gilless (1996) at Berkeley found 86 percent home survival with a clearance of 10 meters or more.

The results of the diverse analytical methods are congruent and consistently indicate that ignitions from flames occur over relatively short distances—tens of meters not hundreds of meters. The severe-case estimate of SIAM indicates distances of 40 meters or less. Experimental wood walls did not ignite at 10 meters when exposed to experimental crown fires. And, case studies found that vegetation clearance of at least 10 meters was associated with a high occurrence of home survival.

As previously mentioned, firebrands are also a principal W-UI ignition factor. Highly ignitable homes can ignite during wildland fires without fire spreading near the structure. This occurs when firebrands are lofted downwind from fires. The firebrands subsequently collect on and ignite flammable home materials and adjacent flammables. Firebrands that result in ignitions can originate from wildland fires that are at a distance of 1 kilometer or more. For example, during the 1980 Panorama Fire (San Bernardino, California), the initial firebrand ignitions to homes occurred when the wildland fire was burning in low shrubs about 1 kilometer from the neighborhood. During severe W-UI fires, firebrand ignitions are particularly evident for homes with flammable roofs. Often these houses ignite and burn without the surrounding vegetation also burning. This suggests that homes can be more flammable than the surrounding vegetation. For example, during the 1991 fires in Spokane, Washington,[5] houses with flammable roofs ignited without the adjacent vegetation already burning. Although firebrands may be lofted over considerable distances to ignite homes, a home's materials and design and its adjacent flammables largely determine the firebrand ignition potential.

Research Conclusions

SIAM modeling, crown fire experiments, and W-UI fire case studies show that effective fuel modification for reducing potential W-UI fire losses need only occur within a few tens of meters from a home, not hundreds of meters or more from a home. This research indicates that home losses can be effectively reduced by focusing mitigation efforts on the structure and its immediate surroundings. Those characteristics of a structure's materials and design and the surrounding flammables that determine the potential for a home to ignite during wildland fires (or any fires outside the home) can be referred to as home ignitability.

The evidence suggests that wildland fuel reduction for reducing home losses may be inefficient and ineffective: inefficient because wildland fuel reduction for several 100 meters or more around homes is greater than necessary for reducing ignitions from flames; ineffective because it does not sufficiently reduce firebrand ignitions. To be effective, given no modification of home ignition characteristics, wildland vegetation management would have to significantly reduce firebrand production and potentially extend for several kilometers away from homes.

Management Implications

These research conclusions redefine the W-UI home fire loss problem as a home ignitability issue largely independent of wildland fuel management issues. Consequently, this description has significant implications for the necessary actions and economic considerations for fire agencies.

One aspect of the Forest Service approach to reducing the W-UI fire problem is to determine where the problem is and focus fuel management activities in those areas. *The Strategic Assessment of Fire Management* (USDA Forest Service 1995) states:

[5]Unpublished video data on file, Rock)' Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

> The Forest Service should manage National Forest lands to mitigate hazards and enhance the ability to control fires in the wildland/urban interface. The risk of wildland fire to communities can be lessened by reducing hazards on Forest Service lands adjacent to built-up areas.... Broad-scale assessment processes for the next generation of forest plans should identify high-risk areas related to the wildland/urban interface... The highest risk areas within the United States should be identified and mitigation efforts directed to these locations (p. 20).

It describes a costly, intensive, and extensive W-UI hazard mapping and mitigation effort specifically for reducing home fire losses. As described, this approach is not necessary.

The congruence of research findings from different analytical methods suggests that home ignitability is the principal cause of home losses during wildland fires. Any W-UI home fire loss assessment method that does not account for home ignitability will be critically non-specific to the problem. Thus, to be reliable, land classification and mapping related to potential home loss must assess home ignitability. Home ignitability also dictates that effective mitigating actions focus on the home and its immediate surroundings rather than on extensive wildland fuel management. Because homeowners typically assert their authority for the home and its immediate surroundings, the responsibility for effectively reducing home ignitability can only reside with the property owner rather than wildland agencies.

Mapping Home Loss Potential

The evidence indicates that home ignitions depend on the home materials and design and only those flammables within a few tens of meters of the home (home ignitability). The wildland fuel characteristics beyond the home site have little if any significance to W-UI home fire losses. Thus, the wildland fire threat to homes is better defined by home ignitability, an ignition and combustion consideration, than by the location and behavior of potential wildland fires.

Home ignitability has implications for identifying W-UI fire problem areas and suggests that the geographical implication of the term “wildland-urban interface” as a general area or zone misrepresents the physical nature of the wildland fire threat to homes. The wildland fire threat to homes is not where it happens related to wildlands (a location) but how it happens related to home ignitability (the combustion process). Therefore, to reliably map W-UI home fire loss potential, home ignitability must be the principal mapping characteristic.

Wildland Fuel Hazard Reduction

Extensive wildland vegetation management does not effectively change home ignitability. This should not imply that wildland vegetation management is without a purpose and should not occur for other reasons. However, it does imply the imperative to separate the problem of the wildland fire threat to homes from the problem of ecosystem sustainability due to changes in wildland fuels. For example, a W-UI area could be a high priority for extensive vegetation management because of aesthetics, watershed, erosion, or other values, but not for reducing home ignitability. Vegetation management strategies would likely be different without including the W-UI home fire loss issue. It also suggests that given a low level of home ignitability (reduced wildland fire threat to homes), fire use opportunities for sustaining ecosystems may increase in and around WUI locations.

W-UI Home Loss Responsibility

Home ignitability implies that homeowners have the ultimate responsibility for W-UI home fire loss potential. Because the ignition and flammability characteristics of a structure and its immediate surroundings determine the home fire loss potential, the home should not be considered a victim of wildland fire, but rather a potential participant in the continuation of the wildland fire. Home ignitability, i.e., the potential for W-UI home fire loss, is the homeowner's choice and responsibility.

However, public and management perceptions may impede homeowners from taking principal responsibility. For example, the Federal Wildland Fire Management, Policy, and Program Review (1995) observes, "There is a widespread misconception by elected officials, agency managers, and the public that wildland/urban interface protection is solely a fire service concern" (p. 23). In the *Journal of Forestry*, Beebe and Omi (1993) concur, stating that, "Public reaction to wildfire suggests that many Americans want competent professionals to manage fire flawlessly, reducing the risks to life, property, and public lands to nil" (p. 24). These statements agree with Bradshaw's (1988) description of the societal roles in the W-UI problem. He observes that homeowners expect that fire protection will be provided by others. Contrary to these expectations for fire protection, the fire services have neither the resources for effectively protecting highly ignitable homes during severe W-UI fires, nor the authority to reduce home ignitability.

An Alternative

Specific to the W-UI fire loss problem, home ignitability ultimately implies the necessity for a change in the relationship between homeowners and the fire services. Instead of all pre-suppression and fire protection responsibilities reading with fire agencies, homeowners should take the principal responsibility for assuring adequately low home ignitability. The fire services become a community partner providing homeowners with technical assistance as well as fire response in a strategy of assisted and managed community self-sufficiency (Cohen and Saveland 1997). For success, this perspective must be shared and implemented equally by homeowners and the fire services.

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Wildland Urban Interface:

The wildland–urban interface (WUI) is commonly described as the zone where structures and other human development meet and intermingle with undeveloped wildland or vegetative fuels. This WUI zone poses tremendous risks to life, property, and infrastructure in associated communities and is one of the most dangerous and complicated situations firefighters face.

Both the National Fire Plan and the Ten-Year Comprehensive Strategy for Reducing Wildland Fire Risks to Communities and the Environment place a priority on working collaboratively within communities in the WUI to reduce their risk from large-scale wildfire.

The Healthy Forest Restoration Act builds on existing efforts to restore healthy forest conditions near communities and essential community infrastructure by authorizing expedited environmental assessment, administrative appeals, and legal review for hazardous fuels projects on federal land. The Act emphasizes the need for federal agencies to work collaboratively with communities in developing hazardous fuel reduction projects, and it places priority on treatment areas identified by communities themselves in a CWPP.

In many areas river bottoms have become WUI areas. This is especially true in Gallatin County. Both the Gallatin and Madison rivers and their many fingers run through the heart of the county more people are finding these areas appealing to move into. Fire history is extensive throughout the county in these areas. Fires in these areas tend to be fast moving due too the thick tall understory and deep seeded because of old growth cottonwood trees.

These areas also have a tendency to be dangerous, because of the old growth cottonwood trees. The trees can be dead or dying with degrading root systems and still have green or growing sections left in the tree. This can be deceptive to the unsuspecting, cottonwood trees are notorious for having green tops and failing root systems, fire in these areas or stands can compound the problems and weaken the trees even more, potentially falling on unsuspecting firefighters injuring them or even causing death.

Every fire district or fire protection agency in Gallatin County has some type of WUI within its jurisdiction, whether it's one subdivision, multiple subdivisions or the whole fire district. It's the goal of this plan to address all of them. When completed these areas of risk will be identified and addressed with suggested remedies.

Current Projects:

Within Gallatin County there are a few good projects that have either been completed or are in some phase of being implemented. Other recommendations will be discussed later in this plan.

WUI planning:

Some jurisdictions within the county have completed their own fire plans within their WUI areas. These include the Rea/Sourdough Fire Departments for the Triple Tree subdivision and surrounding area. The other is the Central Valley Fire Dist. for the Sypes Canyon area at the base of the Bridger Mountain range. Other fire districts have been pre-planning some of their WUI areas to help prepare them if a fire were to occur.

In 2000 the Big Sky Fire Management Strategy was finished and implemented. This was a collaboration between Gallatin and Madison Counties, Gallatin and Beaverhead /Deerlodge National Forests, Gallatin Canyon consolidated Fire District and local residents and stakeholders.

The Gallatin County Department of Emergency Services has been working with FEMA through the Project Impact program to list possible hazards the county and its residents may face. Also being finished is the Gallatin County Pre-disaster mitigation plan (PDM), which will incorporate the CWPP. The PDM is an overall look at all possible disasters from fire and earthquakes to flooding and heavy snow storms.

Another large accomplishment within Gallatin County is the implementation of county wide subdivision regulations concerning WUI areas. When completed and implemented all new subdivisions that fall within a designated WUI area will be subject to these special subdivision regulations.

Mutual Aid program:

Gallatin County has an outstanding mutual aid program (MA). Within the county mutual aid can be requested from any jurisdiction or a group of jurisdictions for any type of emergency. This program has been implemented for many years at this point and continues to be revised and updated. Along with this county MA program Gallatin County is involved with a greater state MA system that allows other counties to call for help from Gallatin County and visa versa.

Water supply:

Water supply is one of the largest concerns and problems within Gallatin Counties fire jurisdictions. Water for fighting fires whether it is in the wildland or a structure fire, is a valuable commodity that can be hard to come by. Many fire jurisdictions continue to do what they can with limited water, and also continue to improve their water supplies. Whether its pressure hydrants or fill site ponds the water supply is slowly getting better. As new subdivisions are being developed this concern is being addressed with subdivision regulation and developer education.

Response:

Response within the county for the most part is great. What needs to be remembered is that the majority of the fire jurisdictions within Gallatin County are volunteer with no paid personnel. During certain times of the day response time may not be favorable due to the fact that most fire department personnel are working their normal jobs. These tend to be the times that jurisdictions rely heavily on mutual aid from other areas.

Fire jurisdictions have been working with smaller budgets and less people for sometime but it is believed that all the jurisdictions within the county are doing their very best with what they have. With smaller budgets and dwindling fire personnel the county mutual aid system is used quite frequently for large incidents. All agencies benefit from the mutual aid system by having neighbors helping neighbors.

Several national standards have been developed to deal with most fire service issues. Included are standards on response, personnel, and training to name a few. What these standards can do for Gallatin Counties agencies is not only give them a goal or standard but also allow agencies to look outside the county and state and find what others are doing or using for standards, then compare or rate themselves.

Regardless of what the “Code of the West” states people moving into our communities have expectations of their fire service. These expectations generally come with the resident as they move from more metropolitan areas.

- **Full service delivery of Emergency Services to include structure, wildland, Emergency Medical, hazardous materials, rescue response etc.**
- **Responses are timely; to arrive on scene shortly after the 911 call is placed. To bring enough equipment and personnel to do the job at hand**
- **Professional well trained personnel**

Fire Dept. Personnel:

Like stated before the fire departments within Gallatin County are facing the same problems that are being faced nationally. Volunteers are the largest number of firefighters in Gallatin County. With only two Fire Departments being full time career (Bozeman FD & West Yellowstone FD) and two being combination (Big Sky & Central Valley) this leaves the remainder as totally volunteer. Finding people to volunteer their time not only for emergencies but also the increased training, department meetings etc. has become increasingly harder. Personnel numbers are down even within the career departments in the county. But even with smaller personnel numbers our fire departments continue to work with what they have and do the best they can for their communities.

Fire Dept: Equipment:

Gallatin County agencies are acquiring new apparatus and equipment every year. With the implementation of the FIRE ACT (A.F.G) grants which are federally funded monies through the Department of Homeland Security, Gallatin County fire departments have been receiving large amounts of money to add or replace equipment. From new fire trucks and water tenders to protective clothing and radio communication equipment, the A.F.G's are only a fraction of the current budgets and are helpful but are not a foundation for those budgets. Also with the MT DNRC Co-Op program which allows agencies to receive wildland fire equipment from the state to use within their own fire districts.

Fire Dept. Training:

Training within Gallatin County is in compliance with national standards and continues to grow. With many avenues for training opportunities department are able to train the personnel they have to a very high standard. The Fire Service Training School and the South Central Zone both offer a wide variety of training classes here in the county at no or low expense to the fire department.

Communications:

Communications within the county continue to get better every year. New radio systems and components are being installed throughout the county to better cover the county as a whole. Old systems are converted and being updated but work well. With a state of the art E911 dispatch center that can process calls and dispatch units within 60 seconds of the call taking place, also having multiple fire repeater towers throughout the county allows agencies not only talk to dispatch but to other agencies in an emergency. Gallatin County is known for being a "high tech" county and this will continue to show in its emergency services communication far into the future.

Insurance Services Organization:

FIRE... It's the largest single cause of property loss in the United States. In the last decade, fires have caused direct losses of more than $120 billion and countless billions more in related costs.

But that's not all. Every year, fires injure more than 20,000 people. And every year, more than 3,000 Americans die in building fires. A community committed to saving lives and property needs trained firefighters, proper equipment, and adequate supplies of water. Insurance companies consider it good public policy — and good business — to promote and encourage the efforts of individual communities to improve their fire-protection services. That's why, for almost a century, U.S. property insurance companies have funded key initiatives aimed at fire prevention and fire mitigation.

In the battle against fire losses, one of the insurance industry's most important weapons is the Public Protection Classification (PPCTM) program from ISO.
The PPC program provides important, up-to-date information about municipal fire-protection services throughout the country. A community's investment in fire mitigation is a proven and reliable predictor of future fire losses. So insurance companies use PPC information to help establish fair premiums for fire insurance — generally offering lower premiums in communities with better protection.

By offering economic benefits for communities that invest in their firefighting services, the PPC program provides a real incentive for improving and maintaining public fire protection. And that incentive produces results.
The program also provides *help* for fire departments and other public officials as they plan for, budget, and justify improvements.

But the most significant benefit of the PPC program is its effect on losses. Statistical data on insurance losses bears out the relationship between excellent fire protection — as measured by the PPC program — and low fire losses.

And in a recent survey of fire chiefs, 97% of the respondents said that the PPC program is important in helping the community save lives and property

Insurance Services Organization: (Cont.)

ISO is an independent organization that serves insurance companies, fire departments, insurance regulators, and others by providing information about risk. ISO's expert staff collects information about municipal fire-protection efforts in communities throughout the United States. In each of those communities, ISO analyzes the relevant data and assigns a Public Protection Classification — a number from 1 to 10. Class 1 represents exemplary fire protection, and Class 10 indicates that the area's fire-suppression program does not meet ISO's minimum criteria.

Virtually all U.S. insurers of homes and business property use ISO's Public Protection Classification in calculating premiums. In general, the price of fire insurance in a community with a good PPC is substantially lower than in a community with a poor PPC, assuming all other factors are equal.

A Community's PPC depends on:

> **Fire alarm and communications systems**, including telephone systems, telephone lines, staffing, and dispatching systems

> **The fire department**, including equipment, staffing, training, and geographic distribution of fire companies

> **The water supply system**, including condition and maintenance of hydrants, and a careful evaluation of the amount of available water compared with the amount needed to suppress fires

ISO's PPC program evaluates communities according to a uniform set of criteria, incorporating nationally recognized standards developed by the National Fire Protection Association and the American Water Works Association. So, the PPC program provides a useful benchmark that helps fire departments and other public officials measure the effectiveness of their efforts — and plan for improvements.

For more information visit ISO on the web at **http://www.iso.com**

Recommendations:

Defensible Space (FIREWISE) workshops

To better prepare ourselves for a forest fire or wildland fire in the WUI, it depends on what we do prior to the fire occurring. Using proper vegetation management around our homes and communities before the fire will improve the survivability of our communities. Defensible space is the area around the house that is clean and well kept and also is known as FIREWISE landscaping.

It is recommended that Gallatin County and its fire protection agencies use a combination of public education and the FIREWISE communities program to better prepare landowners in the WUI for wildland fires. Through our fire departments, Federal partners and the State of Montana DNRC, many resources for education and expertise are available for landowners to use. Landowners and community leaders alike need to be better educated about the WUI and how fire can affect them.

This is a description of the FIREWISE communities program and what it can entail.

Since 1986, the National Wildfire Coordinating Group has overseen the activities of the interagency cooperative National Wildland/Urban Interface Fire Program, which included development of numerous videos and print publications directed at firefighters, homeowners and landscapers. In 1996 the program developed a project that became known as the Firewise Communities Program. Activities in the early stages of this project included the launch of the Firewise home page (www.firewise.org), the organization of a group of national Firewise stakeholders, and the design, testing and delivery of a Firewise Communities Workshop series.

More than 3,000 individuals have participated in more than 30 national Firewise Communities workshops since the program began in 1999, including representatives from more than 1,080 communities in 47 states, Canada, Australia, and US Trust Territories. An estimated 7,000 individuals have participated in regional and local workshops. While the national series concluded in late 2003, the Firewise Communities program continues to support regional and local organizations interested in hosting Firewise workshops by supplying materials and facilitator training.

As a practical follow-up to the workshop series, the national Firewise Communities/USA recognition program was developed to facilitate local solutions to wildfire preparedness goals and to recognize communities for working together to protect residents and property from fire in the wildland/urban interface. At the end of 2004, state foresters from 39 states have assigned Firewise Communities Liaisons to implement the Firewise Communities/USA Recognition Program in their states. More than 90 communities in 26 states have received recognition to date. (8)

(Continuation of FIREWISE)

Reduce amount and types of fuels
Reduce or eliminate highly flammable plants, especially those that overhang chimneys and roofs; and clear away dead brush and wood regularly.

Eliminate ladder fuels
Eliminate ladder fuels which enable a fire to climb into low hanging branches of trees and then to the home. Pruning tree branches six to ten feet helps reduce the ladder effect.

Create fire breaks
Driveways, open expanses of lawn, and walkways can interrupt a fire's path.
The analyses of wildland-urban interface fires show that as the distance of dense, flammable vegetation from a house increases so do its chances of survival.

Provide a defensible space
A well-maintained lawn or ground cover provides an effective and attractive defensible space by keeping fire a safe distance from the house. It also provides fire fighters an area to locate equipment and hoses to further protect the structure.

Carefully space trees
Trees should be carefully spaced to reduce the density of vegetation. The removal of flammable debris interrupts the fire's path.
Some designs use mulch such as pine needles as natural walkways.

Use fire resistant materials
A more fire-conscious selection is the use of rock for walkways instead of the more traditional and flammable mulch.
These guidelines provide only a framework for creating fire safe landscapes.
Remember, fire safety doesn't mean stripping away everything from around the home.
Although dead leaves can allow fire to spread, removing all leaf litter depletes the soil of nutrients.
And, though pruning is a sound way to eliminate ladder fuels, improper pruning damages plants and trees and disrupts the environmental balance of the property.

County Recommendations

1. Subdivision Review/Regulations

Continue to review and update WUI subdivision regulation to reflect changing conditions and/or areas.

2. Unprotected Area

Within Gallatin County there are still many areas that are not protected by a particular full service fire protection agency. These areas fall under the protection of Gallatin County Fire, but provide wildland fire services only. In the long term these areas should be closely looked at, and incorporated into current fire protection agencies. Not only will this be beneficial to our county residents by providing them with full fire department services, but possibly will help with the maintaining of tax funds for that fire protection agency.

3. Fire Impact Fees

Currently Gallatin County Fire agencies have to reevaluate their fire impact fees, it's the recommendation that all fire agencies evaluate and collect impact fees for fire service use. Fire protection agencies can use their impact fees for the addition of either new apparatus and or new facilities.

4. Continuation of practices

It is this plans recommendation to continue with the many programs that are in place for emergency services. To continue to review and revise these plans in the future is in the best interest of the County and its Emergency Services.

- Mutual Aid/ Automatic aid
- 911 dispatch
- GIS
- Water Supply
- Fire Districts/ Fire Service Areas
- Road/ Bridge Standards
- Alert Warning Systems
- County Planning
- Impact Fees
- Communications

5. Public Education

It is recommended that more public education be done within the county, to take advantage of current scheduled annual or biannual home owner association meetings, public events and trade shows. Public Education can be challenging due too the amount of information and the complexity of issues. With partnerships between local, state and federal resources and with everyone having a common goal public education becomes easier.

6. Mitigation Project Work

Gallatin County with the help of the Gallatin National Forest and the MT Department of Natural Resources, need to identify landowners within Gallatin County who are willing to create defensible space or a general wildfire mitigation area as a demonstration project. It's this plans recommendation that multiple areas be found possibly one in the North and one area to the South as demonstration areas.

7. Fire Jurisdiction Protection Overlap

It is recommended that current fire protection jurisdictions with overlapping protection boundaries immediately define their boundaries and retract those boundaries that fall within the protection of Federal or State jurisdictions.

8. Mapping

It is recommended that Gallatin County and the fire protection districts within the county continually revise and update GIS data for use in mapping and emergency response. It is the responsibility of each fire jurisdiction to work with Gallatin County GIS department to accomplish this task.

9. Response Plans

Fire Jurisdictions in coordination with Gallatin County Sheriffs office, and DES coordinators develop and adopt WUI response plans for their individual use. It is the overall goal of the Gallatin County CWPP to include a large scale, overall county WUI response plan.

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Wildfire Mapping

Mapping conducted for this Wildfire plan has been developed from many areas and by many people, the information contained will describe each map design and the data that was used to build the map.

Fire Districts/service areas

This is a basic map containing legal boundary data of Gallatin County and all of the fire districts/service area's located within the county. Also contained on this map are general locations of fire district/service area fire stations.

Land Ownerships

This map contains legal boundary data of land ownership within Gallatin County, Local, State and Federal lands.

Land ownership with historic fires

This map contains the same information as the above but adds historic fire perimeters and locations obtained from the US Forest service falling within the Gallatin National Forest. Data has been collected over the past 6-8 years and only reflects fires that wither were on or near national forest property.

Fire Risk – Values at Risk
Fire Risk – Hazard

Described below by Fire Logistics.

Gallatin County CWPP Plan

Geographic Information Systems Model Documentation

Fire Logistics, Inc. of Montana City, Montana was contracted to assist Gallatin County in the development of a countywide wildland urban interface plan. Outlined below are the basic steps and specifications used in the geographic information system (GIS) model process.

Wildland Urban Interface Risk Analysis Model

Step 1: Objective

Develop a wildfire hazard-risk assessment to evaluate the fuel hazards and the resources at risk to wildfire. The model is descriptive and not predictive.

Step 2: Data Description

A gird or vector layer of accumulated point values will be created for each of the 3 wildfire data models: hazard, values at risk and risk. The models will be represented separately and combined resulting in a final map depicting low, moderate or high risk for catastrophic fires.

Hazard Model

Hazard parameter is defined as the physical or biological factors resulting in similar fire behavior characteristics and may result in an undesired wildfire event. The model was developed using slope, aspect, elevation and land cover type. Each criteria was weighted with land cover type weighted X 10 the slope, aspect, and elevation. A low, moderate or high rating indicates the potential for extreme fire behavior.

	Data Class	Data acquired from:
a. Slope	Grid	30m DEM
b. Aspect	Grid	30m DEM
c. Elevation	Grid	30m DEM
d. Land Cover	Grid	30m USGS Land Cover data

A raster grid will be created for slope, aspect, elevation, and land cover with weight values assigned to each cell by criteria identified in appendix A. Points will be totaled for the four grids and a final raster grid created (see Process 3).

Based on the accumulated points for each criteria in the hazard data model a final point value will be assign for each watershed with a low, moderate or high risk rating.

Value at Risk Model

Value, or human development data parameter, is defined as natural or developed features that can be affected by fire. Attributes for parcels with structures are extracted from the CAMA data and a point value is assigned for each parcel based on structure presence. See Appendix A for values.

Risk Model

Risk model is in the process of be re-defined—documentation is coming…

Step 3: Methodology

Hazard Model Data

1. Use raster calculator and conditional statement to assign point values for each 30m cell in grid data based on criteria determined by project management team. (See appendix A for criteria point value)

	L	**M**	**H**
Slope	1	2	3
Aspect	1	2	3
Elevation	1	2	3
Land Cover	10	20	30

2. Create aggregate hazard grid from 4 grids created above using raster calculator to combine point value of each cell creating one final hazard grid with total point sum assigned to individual cells.

   Expression: *hazard_pts* = slope_pts + aspect_pts + elev_pts + lc_pts

3. The final grid point value will represent low, moderate, or high wildfire risk for the hazard model based on accumulated point value in Step 4.

Values at Risk Model Data

1. Extract desired CAMA data field from residential text file using extraction program. Reclassify values in the PROPTYPE field per the specifications in Appendix A.

More documentation to be written

RISK MODEL DATA

To be written

Step 4: Results

Final Fire Hazard Assessment Model

A grid or vector layer will be created for each of the three models. The final base map will consists of the fuel hazard model, in 30m raster format, assigned low, moderate, or high fire hazard and delineated by 5th code watershed. This hazard model will be overlaid with the values at risk model (parcels with structures) and risk model (# of fire occurrences) models. The map will be labeled with number of developed parcels in each watershed.

1. **Accumulated Hazard Model Point Sum**
   Final Grid = Hazard_Pts

NO RISK	**4 - 9**
LOW RISK	**14 - 19**
MODERATE RISK	**20 - 24**
HIGH RISK	**25 - 29**

2. **Accumulated Values at Risk Model Point Sum**
   Value Points =

   No point value assigned. Future analysis by watershed will be needed based on structures at risk. Number of structures will be represented in each watershed.

3. **Accumulated Risk Model Point Sum**
   Risk Points =

LOW RISK	**2**
MODERATE RISK	**4**
HIGH RISK	**6**

3. **A final coverage "Fire_Assessment_Model" will be created merging hazard, values, and risks creating a final map depicting low, moderate, or high wildfire risk.**

4. **Color Map:**

Low Risk	Green
Moderate Risk	Yellow
High Risk	Red

5. Test model.

HAZARD MODEL SPECIFICATIONS

Terrain Model Criteria

SLOPE	**Weight**
< 10%	(1)
10-30%	(2)
> 30%	(3)
ASPECT	
N, NW, NE	(1)
E or level	(2)
SE, S, SW, W	(3)
ELEVATION	
> 5500’ or 1676.4 m	(1)
3500-5500’	(2)
< 3500’ or 1066.8 m	(3)

LAND COVER CODES (USGS Land Cover Classification)

(Vegetation types are classified using fire behavior fuel models.)

	Weight
NONE	(0)
LOW	(10)
MODERATE	(15)
HIGH	(20)

NONE

11	Open Water
12	Perennial Ice/Snow
31	Bare Rock/Sand/Clay
32	Quarries/Strip Mines/Gravel Pits

LOW

22	High Intensity Residential
23	Commercial/Industrial/Transportation
33	Transitional
71	Grasslands/Herbaceous
81	Pasture/Hay
82	Row Crops
83	Small Grains
84	Fallow
85	Urban/Recreational Grasses
92	Emergent Herbaceous Wetlands

MODERATE

21	Low Intensity Residential
41	Deciduous Forest
51	Shrubland
91	Woody Wetlands

HIGH

42	Evergreen Forest
43	Mixed Forest

VALUES AT RISK MODEL CRITERIA

PROPTYPE	Value
Exempt Property	0
Agricultural Rural	6
Farmstead Rural	12
Residential Rural	12
Residential Urban	12
Vacant Land Urban	0
Commercial Urban	12
Vacant Land Rural	0
Commercial Rural	12
Centrally Assessed	9
No Data	0

RISK MODEL CRITERIA

Weight

IN PROGRESS….

Will use roads, trails, railroads, campgrounds, structures, and historic fire occurrences

Agency Demographics:

The fire service community in Gallatin County is as diverse as the county itself. Within Gallatin County there are 20 established fire protection agencies, also to include the US Forest Service and the MT DNRC. These fire protection agencies range in size and shape and have their own uniqueness. However, all the area fire protection agencies have similarities and all share common goals: protection of life and property and the stabilization of emergency incidents. To do this many approaches are used, not only in emergency response but in public education, fire prevention, community assistance, and emergency preparedness.

Amsterdam Rural Fire District:

Located south west of Belgrade, this community is largely agricultural. Amsterdam includes the community's of Amsterdam and ChurchHill. Norris road makes up the South Boundary and the North Boundary is the Amsterdam/Manhattan School district boundary. With a small staff and one fire station, the Amsterdam fire department is experienced and dedicated.

Belgrade City Fire Department:

The Belgrade City Fire Department provides services for the City of Belgrade, its residents and guests. Although a separate organization with its own equipment it shares staff and management with the Central Valley Fire District. The Belgrade City Fire Department is governed by the Belgrade City manager and the city council. Belgrade is the second largest city behind Bozeman with approximately 8,000 people in Gallatin County. Belgrade has been listed as the fastest growing city in MT for numerous years and continues to grow at an explosive pace.

Bozeman City Fire Department:

Bozeman is the largest city within Gallatin County and the county seat. Bozeman FD provides service to the city of Bozeman and its residents. This includes Montana State University and other county buildings and property. The Bozeman Fire Department is the only full time all career department in Gallatin County, with 26 suppression employees operating out of two stations they provide service for approximately 31, 000 people.

Bridger Canyon Rural Fire District :

Bridger Canyon is located East of Bozeman, with its boundary starting at the North/West edge of the city limits and following Bridger Canyon Rd East to the county line. North and South boundaries are the USFS forest line. Bridger Canyon FD includes the MT Fish Wildlife and Parks fish hatchery, the Kelly Canyon area, Jackson Creek area and the Bridger Bowl Ski resort. With USFS forest boundary to their North and South access into the Bridger Canyon area can be tricky. With heavy snow fall in the winter months and a narrow highway access to many areas and homes can be cut off form access.

Central Valley Fire District:

The Central Valley Fire District is the largest fire district in the county not only in area covered but also in personnel and equipment. CVFD provides services to approximately 20,000 people and has a service area of about 250 square miles. CVFD provides Advanced Life Support medical services as well as other full fire/rescue service responses to its residents and guests.

CVFD currently employ's 9 full time career personnel including the Fire Chief, 3 Assistant Fire Chiefs, Training Officer, Clerk and 3 firefighter/paramedics that supplement and support a volunteer staff of about 50 people. Although separate CVFD and the Belgrade Fire Department share equipment, personnel and management staff.

Clarkston Fire Service Area:

The Clarkston/PPines fire service area is located Northwest of the Town of Three Forks. The Clarkston area is a small community containing mostly agriculture and also is home to the Lusinac Talc plant.

Fort Ellis Fire Service Area:

The Fort Ellis FD is located East of Bozeman and extends to the county line with Park County at its most Eastern Border. With a staff of approximately 25 personnel running out of a single station, the Fort Ellis FD runs many wildland fires every year. With a large part of their fire district located in or adjacent to forested property, including state, federal and private the Fort Ellis FD continues to have many challenges with WUI.

Gallatin Canyon Consolidated Rural Fire District:

Big Sky FD is located in the Gallatin Canyon; Big Sky RFD is a consolidated fire district, meaning Big Sky RFD Provides service in both Gallatin and Madison Counties. This area includes Big Sky Ski Resort, Moon Light Basin Ski Resort, Spanish Peaks Resort, Gallatin Canyon and surrounding areas. With a combination staff of both career and volunteer personnel the Big Sky Fire District protects a wide range of area. Surrounded by national forest and the Gallatin River to the East most of the Big Sky District is WUI.

Gallatin County Rural Fire:

Gallatin County Rural Fire is its own organization with duties being split between the fire protection agencies within the county. Local fire protection agencies house county owned and/or state owned equipment that is on loan for county fire use. The purpose of County Fire is to respond and control all wildland fires that may occur in areas not protected by a specific fire agency. County Fire is governed by the Gallatin County Commissioners, the County Fire Warden and deputies.

Gallatin Gateway Rural Fire District:

The Gallatin Gateway Rural Fire District is located south of Belgrade and West of Bozeman. GGRFD boundaries start at the Four Corners area and continue South through the Gallatin Canyon. With a good mix of both forested property and open space Gallatin Gateway is a growing community. With two stations and approximately 15 volunteer firefighters the GGRFD continues to grow with more development every year.

Gallatin River Ranch Rural Fire District:

The Gallatin River Ranch is a private community that is located outside of the Town of Manhattan. This community consists of wide open space and large property plots. The Gallatin River Ranch was established many years ago and continues to grow with more and more homes being added to the community every year.

Manhattan City Fire Department:

Located West of Belgrade along I-90 interstate, the Town of Manhattan is a growing community that has seen a large expansion in building over the last couple of years. With new subdivisions and commercial buildings being built the need for regulation, planning and education has increased. Although two separate agencies, the Manhattan RFD and the Manhattan City Fire Departments operate with the same staff, equipment out of the same facility.

Manhattan Rural Fire District:

The Manhattan Rural Fire District protects the surrounding area of the Town of Manhattan. Agriculture land, large farms and open space Manhattan RFD responds to numerous wildland fire calls every year. Although two separate agencies, the Manhattan RFD and the Manhattan City Fire Departments operate with the same staff, equipment out of the same facility.

North Side Rural Fire District:

The North Side Fire District is located in the southern part of Gallatin County. North Side RFD provides service to the area surrounding The Town of West Yellowstone and the Hebgen Lake area. The North Side area is forested with both national forest and Park service bordering their district.

Rae Fire Service Area:

The Rae Fire Service are is located South West of the City of Bozeman, the Rea FSA consists of x firefighters operating out of 1 station. Rea Fire Station is located on Gooch Hill Rd and the Rea FSA shares a station 2 on Cottonwood Rd just south of Anderson School. The Rea FSA shares personnel and equipment with the Sourdough Fire District located to its

Sedan Rural Fire District:

The Sudan RFD is located on the East side of the Bridger Mountain Range. The Sudan RFD is a small fire district that is currently being revamped and reorganized. Equipment from around the valley has been donated to the fire district so that they may provide a better service to their residents and community.

Sourdough Rural Fire District:

The Sourdough Rural Fire District is located straight south of the City of Bozeman, this area has seen a large amount of growth over the years. Sourdough RFD operates out of 2 fire stations, station being located on S.3rd Ave and station 2 on Cottonwood Rd. just South of Anderson School. The Sourdough RFD shares its personnel with the Rea Fire Service.

Springhill Community Fire Service Area:

The Springhill community fire service area is located North East of Belgrade and consists of large farms and family ranches. With a small dedicated volunteer force of 16 the Springhill FSA responds to wildland fires within their area. Although the Springhill FSA may not fight structural fires, the community is close knit and is always willing to help a neighbor in need.

Three Forks City Fire Department:

The Three Forks City Fire Department provides full fire/rescue service to the Town of Three forks. With a combined staff the Three Forks Fire Department can provide a high level of service to its community and residents.

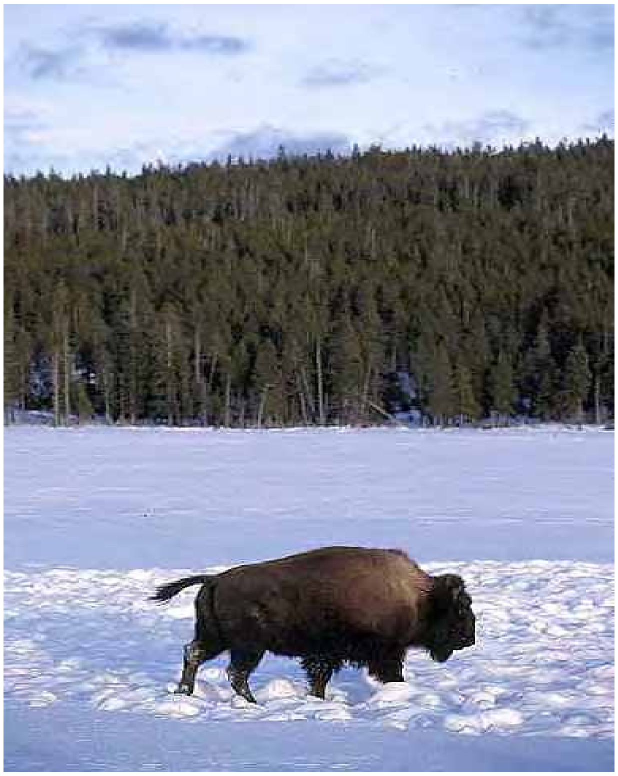
Also located in Three Forks is the Three Forks Ambulance which responds to all medical emergencies within the Three Forks and Willow Creek area for EMS transport.

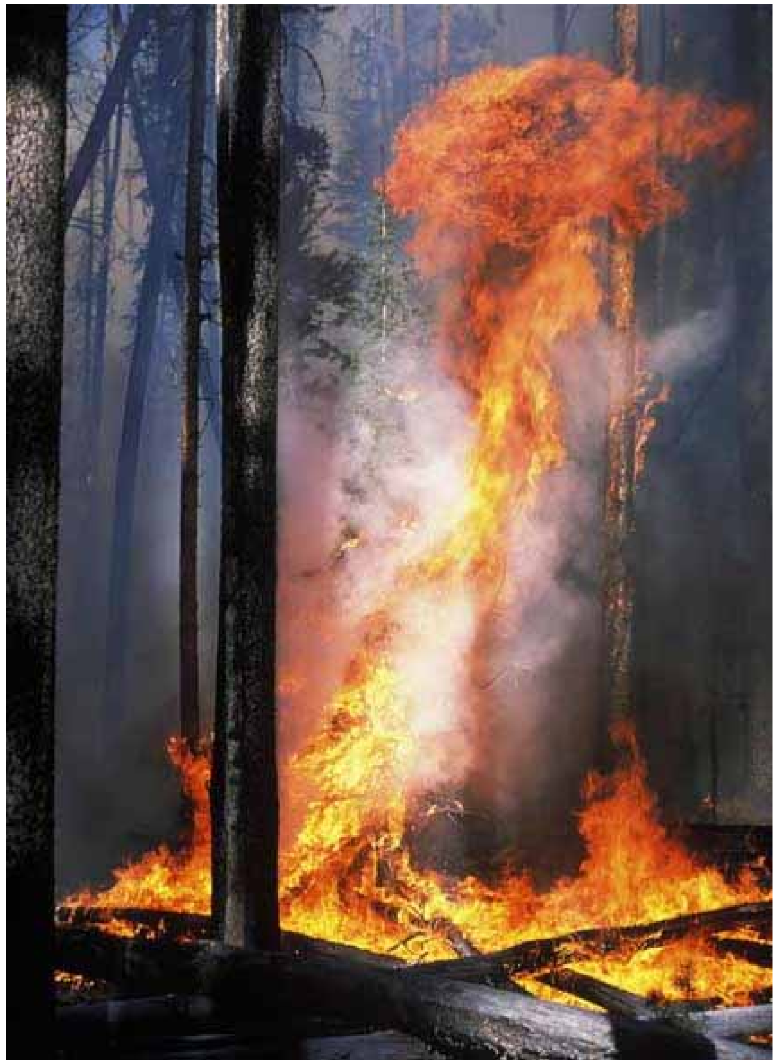
Three Forks Rural Fire District:

Three Forks RFD provides service to the area surrounding the Town of Tree Forks. With combined staff and equipment the Three Forks RFD and the Three Forks city FD are separate but one in the same. With mainly agriculture land and open space, the Three Forks RFD stays busy with wildland fires during the spring, summer and fall months. Combined there are 28 volunteers with more than 48 hours of annual training for every person. Some of Three Forks RFD district spans into Broadwater County, which is also included in this plan.

West Yellowstone Fire Department:

The West Yellowstone FD provides service for the Town of West Yellowstone. This is a combination department that is located at the Southern most end of Gallatin County. West Yellowstone borders Yellowstone National Park and the Idaho state border. Thousands of people travel through West Yellowstone every year while visiting Yellowstone National Park.





Willow Creek Rural Fire District:

The Willow Creek RFD is located in the Western end of the county, Willow Creek FD operates out of one station with a staff of approximately 25 personnel, and the Willow Creek Fire Department is dedicated to providing the very best service to its community and citizens.

Hazard Assessment:

Within Gallatin County there are many WUI Hazard areas. The areas that were evaluated during the first phase of this plan are ranked using an assessment system. The assessment system is simple yet specific enough to classify areas with a high, moderate or low classification. Each community or area is classified for future mitigation purposes as well as for preplanning purposes.

With ranking assigned to areas and communities, the ability to attain funding is greater. Also the ability to identify areas for concern if a fire were to occur is helpful not only to the home owners that live in that area but for the fire departments that may be responding to an incident. With a preliminary preplan in hand at the very least departments and responding personnel will have maps, fire history, current fire protection, and an overview of the structures that are located in that area.

High Risk Areas:

A high risk area is described as being an area were wildland fire is undesirable due too population of that area, ecosystem, infrastructure or other land uses. Fires in these areas have potential to be large scale and cause major property damage or resource loss. With aggressive suppression and tactics the risk to firefighters and personnel is high, which also brings high suppression costs.

Moderate Risk Areas:

These areas are again undesirable for wildland fire, due too current conditions. Suppression and tactics will be aggressive to keep fires small and acreage to a minimum. Although fire is undesirable, with proper treatment and restoration these areas may permit fire at some time in the future. Keeping these areas in check from catastrophic wildfire is key. By using proper treatments and prescribed fire, we can maintain a healthier ecosystem less prone to large scale fires.

Low Risk Areas:

These are areas that can be allowed to burn, either with prescribed fire or natural fire. These areas will be controlled but allowed to burn without or few negative effects. These areas can be suppressed with concern to cost and firefighter resources, but may not result in minimum acreage burned.

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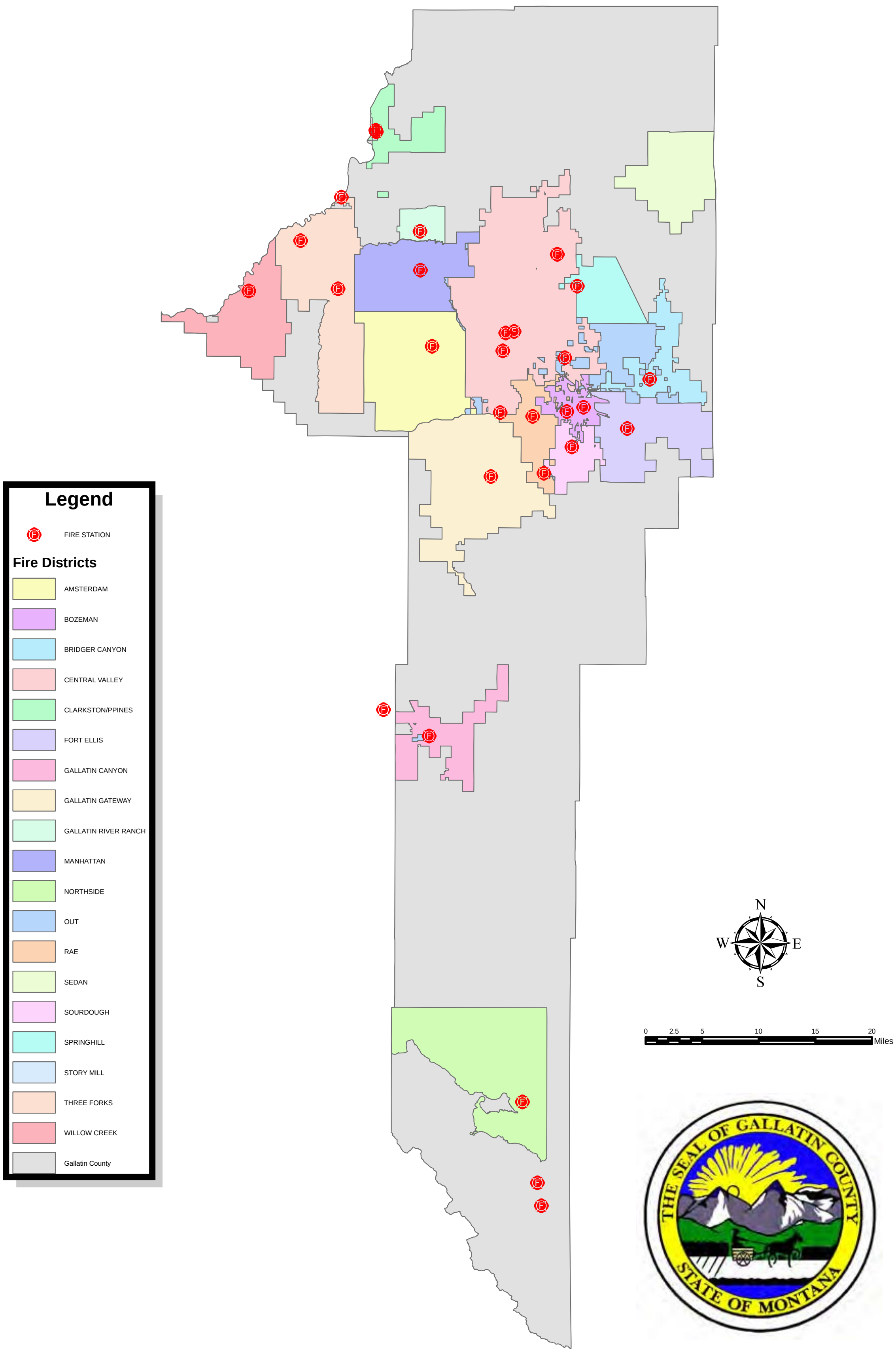
Appendix A

Map Index

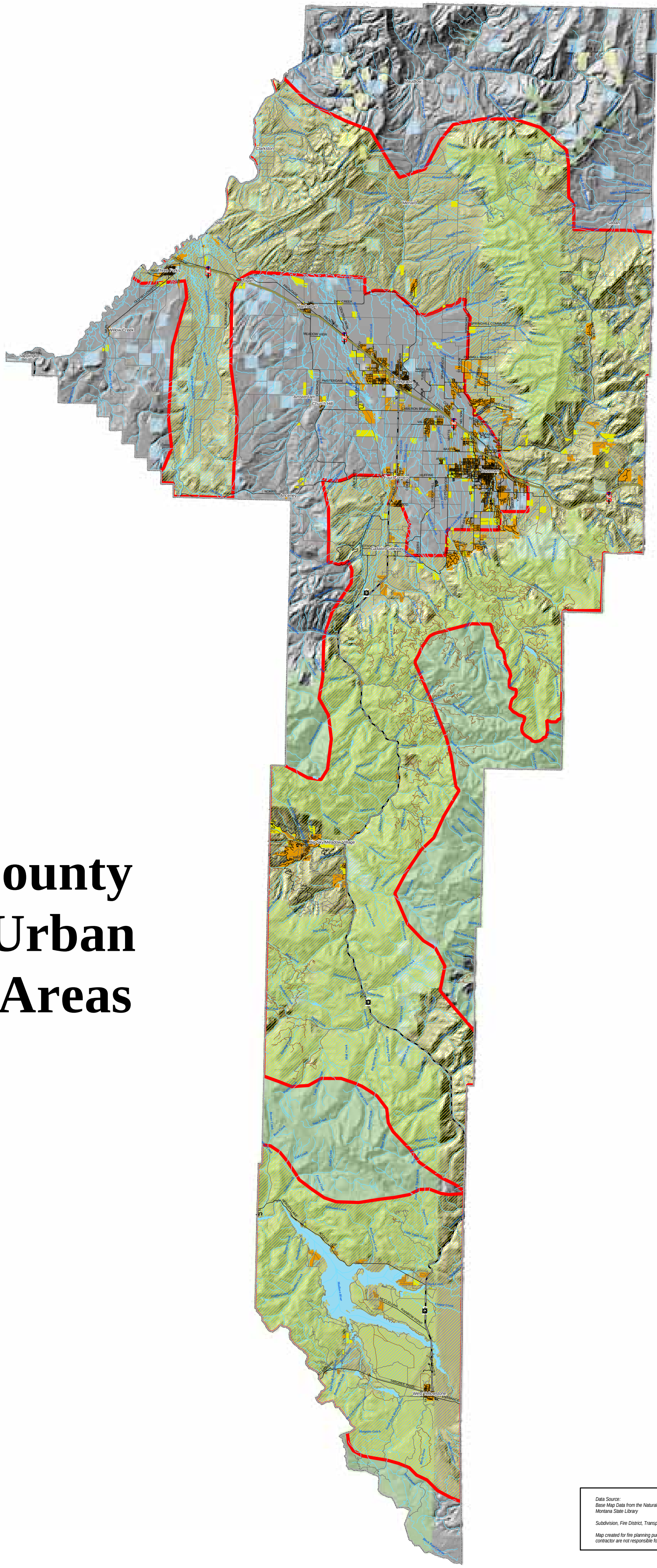
- Fire Districts
- Land Ownership
- Land Ownership
  With Historic Fires
- G.N.F. Historic Fires
- WUI Boundary
- Fire Risk –Hazard
- Fire Risk – Values at Risk

Gallatin County Fire Districts



Gallatin County Community Wildfire Protection Plan
03/2006

Gallatin County Wildland Urban Interface Areas



Gallatin Co. Map Legend

- Wildland Urban Interface Areas And/Or Threats
- Interstate
- State or Secondary Highway
- Secondary and Local Paved Roads
- UNPAVED
- Forest Road
- Major Subdivision
- Minor Subdivision
- US Bureau of Land Management
- US Fish & Wildlife Service
- US Forest Service
- Montana State Trust Lands
- Montana FIsh, Wildlife & Parks
- Montana Department of Transportation

Data Source:
Base Map Data from the Natural Resource Information System, Montana State Library

Subdivision, Fire District, Transportation Data from Gallatin Co.

Map created for fire planning purposes only. County and contractor are not responsible for any inaccuracies within.

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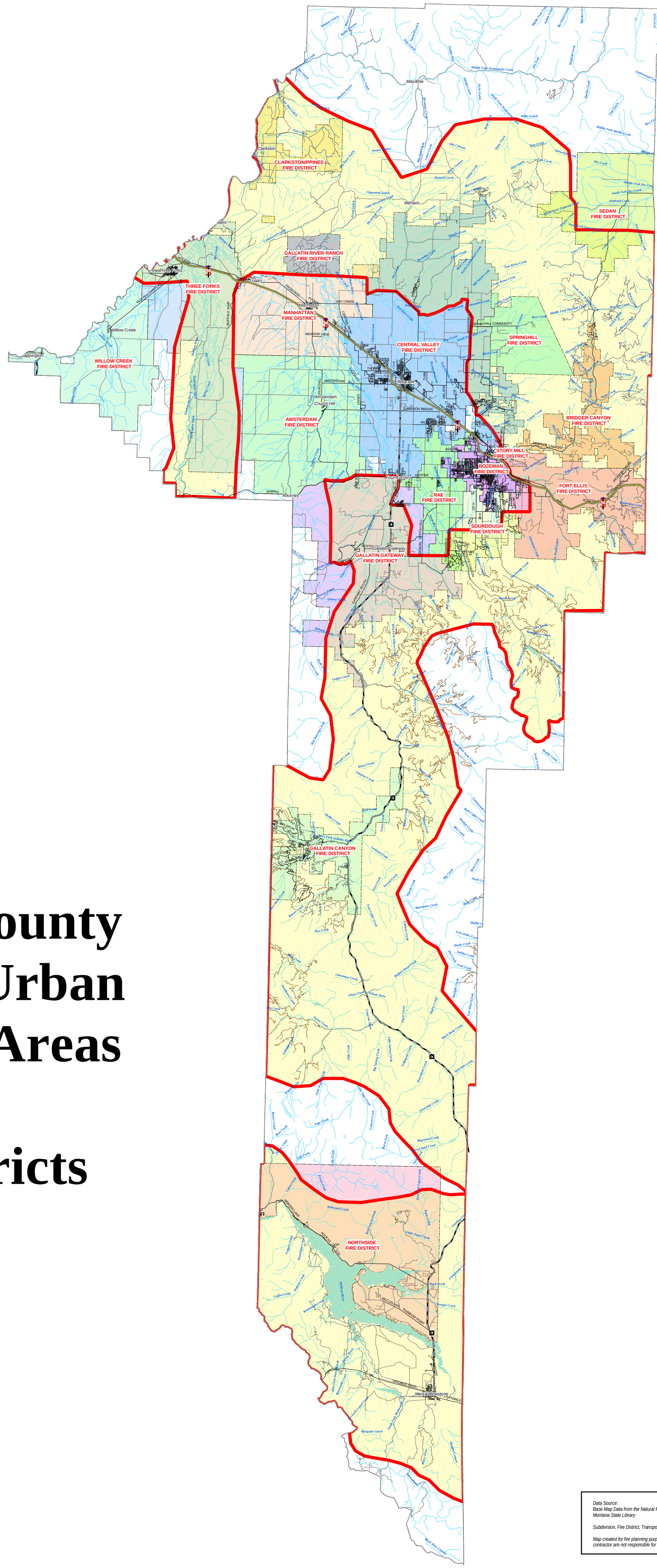
Gallatin County Wildland Urban Interface Areas and Fire Districts



Gallatin Co. Map Legend

- Interstate
- State or Secondary Highway
- Secondary and Local Paved Roads
- UNPAVED
- Forest Road
- Wildland Urban Interface Areas And/Or Threats

Fire Districts

- AMSTERDAM
- BOZEMAN
- BRIDGER CANYON
- CENTRAL VALLEY
- CLARKSTON/PPINES
- FORT ELLIS
- GALLATIN CANYON
- GALLATIN GATEWAY
- GALLATIN RIVER RANCH
- MANHATTAN
- NORTHSIDE
- RAE
- SEDAN
- SOURDOUGH
- SPRINGHILL
- STORY MILL
- THREE FORKS
- WILLOW CREEK

Data Source:
Base Map Data from the Natural Resource Information System, Montana State Library

Subdivision, Fire District, Transportation Data from Gallatin Co.

Map created for fire planning purposes only. County and contractor are not responsible for any inaccuracies within.

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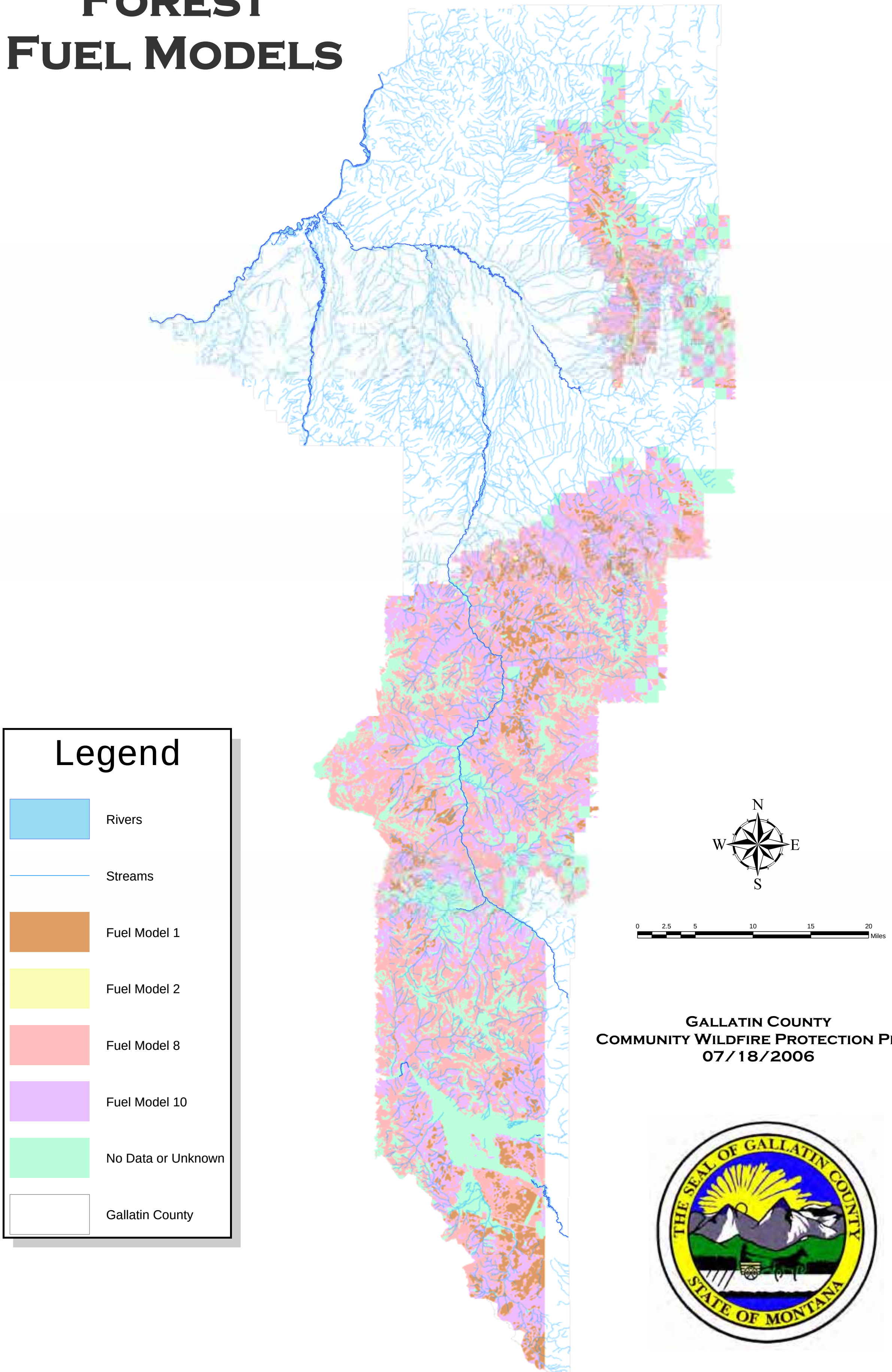
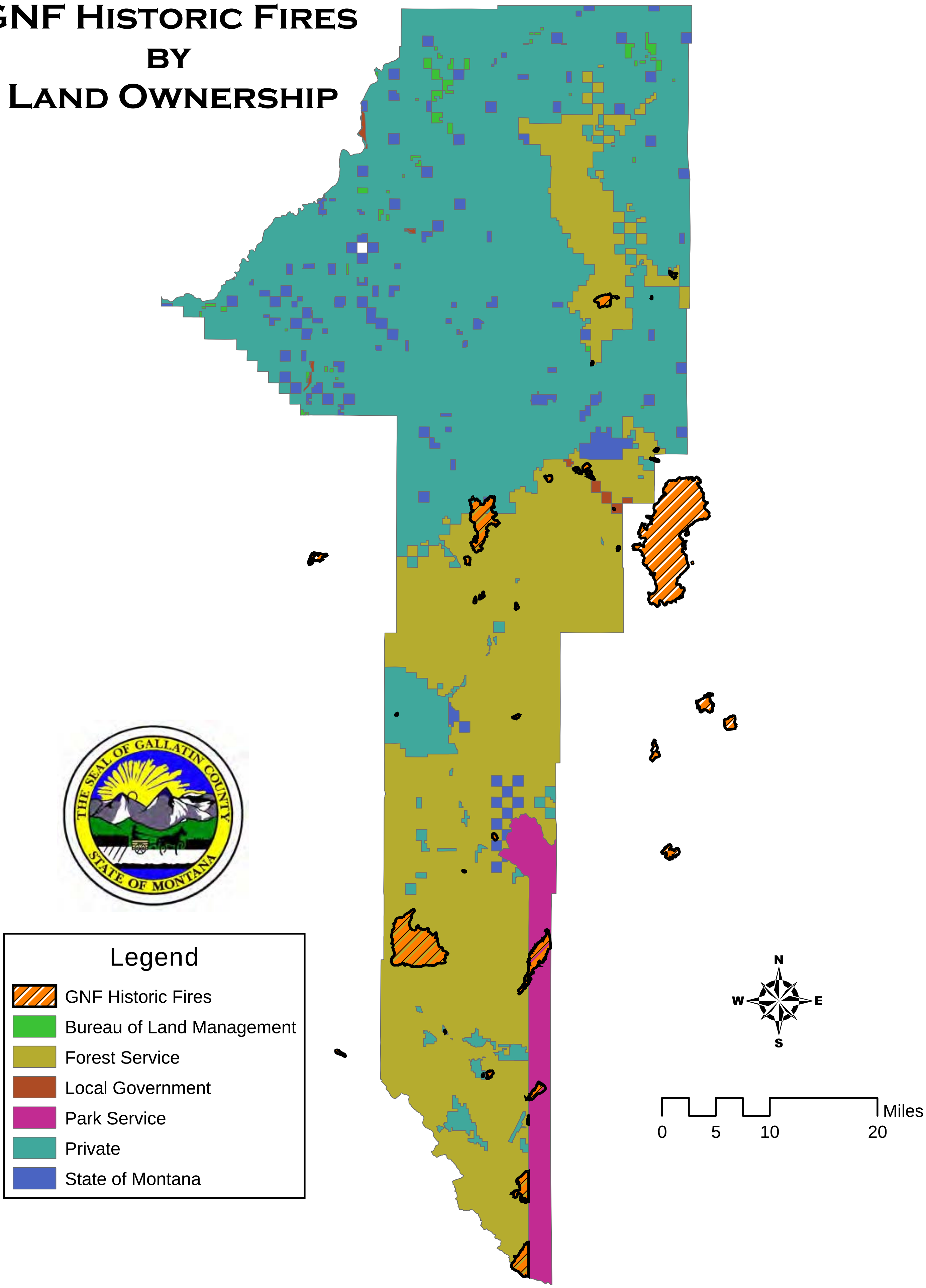
gallatin_districts_E.mxd 9-25-2006

Gallatin Nation Forest Fuel Models



Gallatin County
Community Wildfire Protection Plan
07/18/2006

GNF Historic Fires by Land Ownership



Appendix B

MONTANA CODE ANNOTATED

7-33-2125. Annexation of adjacent territory not contained in a fire district.

(1) Adjacent territory that is not already a part of a fire district may be annexed in the following manner:

(a) A petition in writing by the owners of 50% or more of the area of privately owned lands of the adjacent area proposed to be annexed who constitute a majority of the taxpaying freeholders within the proposed area to be annexed and whose names appear upon the last-completed assessment roll must be presented to the board of trustees of the district for approval. If the proposed annexation is approved by the board of trustees, the petition must be presented to the board of county commissioners.

(b) At the first regular meeting of the board of county commissioners after the presentation of the petition, the commissioners shall set a date to hold a hearing on the petition. The date of the hearing may not be less than 4 weeks after the date of the presentation of the petition to the board of county commissioners. The board of county commissioners shall publish notice of the hearing as provided in 7-1-2121.

(2) On the date set for the hearing, the board of county commissioners shall consider the petition and any objections to the annexation. The board shall approve the annexation unless a protest petition signed by a majority of the landowners of the area proposed for annexation is presented at the hearing, in which case the annexation must be disapproved.

(3) The annexed territory is liable for any outstanding warrant and bonded indebtedness of the original district.

History: En. Sec. 3237, Pol. C. 1895; re-en. Sec. 2081, Rev. C. 1907; amd. Sec. 1, Ch. 16, L. 1915; amd. Sec. 1, Ch. 16, L. 1921; re-en. Sec. 5148, R.C.M. 1921; amd. Sec. 1, Ch. 15, L. 1931; re-en. Sec. 5148, R.C.M. 1935; amd. Sec. 1, Ch. 118, L. 1945; amd. Sec. 2, Ch. 97, L. 1947; amd. Sec. 1, Ch. 75, L. 1953; amd. Sec. 1, Ch. 75, L. 1957; amd. Sec. 1, Ch. 48, L. 1959; amd. Sec. 1, Ch. 77, L. 1959; amd. Sec. 1, Ch. 49, L. 1963; amd. Sec. 1, Ch. 45, L. 1969; amd. Sec. 2, Ch. 81, L. 1977; R.C.M. 1947, 11-2008(4)(a); amd. Sec. 1, Ch. 678, L. 1983; amd. Sec. 65, Ch. 354, L. 2001

Appendix C

APPENDIX I: FIRE PROTECTION PACKAGES

1. **General Fire Protection Requirements.** All of the fire protection requirements in this Appendix apply to all subdivisions.

1.1 Where review or approval of any fire protection requirement is to be performed by the Fire Protection Authority Having Jurisdiction (FPAHJ), another qualified authority or expert, approved by the FPAHJ, may provide such review or approval at the expense of the subdivider/property owner.

1.2 Access to and from and within the subdivision – All roads shall meet or exceed Gallatin County road standards, including but not limited to construction, width and grade. The access routes shall be approved by the FPAHJ.

1.3 The FPAHJ may require a particular fire protection plan (fill sites, tanks, sprinklers, etc.). The FPAHJ may also require additional fire protection features depending on the subdivision fire protection requirements.

1.4 Use of Existing Fire Protection Water Supply Features – Credit for the use of existing fire protection water supply features may be considered by the FPAHJ provided the feature meets the current applicable Gallatin County Fire Council fire protection standards and be approved by the FPAHJ. A written plan shall be provided to and approved by the FPAHJ providing for funding, use, maintenance and future upgrades of the feature. If the proposed plan requires any cooperative agreements, or actions, between the subdivider/property owner and any other party, those shall be completed prior to the proposed plan being accepted by the FPAHJ. This includes but is not limited to contracts, joint ownership, etc.

The subdivider/property owner shall provide, at their expense, current performance test data for the fire suppression water supply system based on current field measures, certified in writing by a professional engineer licensed in Montana. The subdivider/property owner shall provide detailed descriptions and specifications and drawings of the as-built construction and water supply system components of the pond, water main system, pump, and hydrant(s) to the FPAHJ. The FPAHJ may require the subdivider/property owner to pay for an independent validation review of the fire protection water system by a Professional Engineer ("P.E.") licensed in Montana and approved by the FPAHJ.

1.5 Any structure over 3,600 square feet or with a building height greater than 35 feet shall be subject to additional requirements for fire protection water supplies (amount, delivery rate, and location) as described according to the construction and square footage of the structure in the current edition of Fire Code adopted by the State of Montana. The FPAHJ may accept the installation of an approved fire protection sprinkler system meeting the current, applicable National Fire Protection Association (NFPA) standard in place of, and equivalent to, the additional fire protection water supply requirement specified in this Appendix.

1.6 Fire Protection Covenants – All covenants required to meet the fire protection requirements shall be recorded with the subdivision final plat. Any amendment to the fire protection covenants must be approved by the County Commission and the FPAHJ. The FPAHJ is granted standing in the covenants of the subdivision for the purpose of enforcing all fire protection requirements. A fire protection note, calling attention to the fire protection requirements shall be placed on the final subdivision plat.

The following covenants may, at the discretion of the FPAHJ, be included as a requirement of the fire protection plan to mitigate potential threats from fire. This list is not all inclusive:

a. Maintenance of Fire Protection Water Supply Features and Fire Department Use (i.e., open water fill sites, buried water tanks) – Fire protection features must be maintained to their original performance capability in perpetuity by, and at the expense of, the property owners. Performance of all fire protection features shall be certified annually, by the use of field measures, by the FPAHJ or by a PE licensed in Montana. If a PE is to be used, a report shall be submitted, in writing, to the FPAHJ to ensure continued specified capability. The annual certification by the PE shall be at the expense of the property owners. The PE shall be approved by the FPAHJ.

The fire department shall have unrestricted use, in perpetuity (at no cost to the fire department) of the fire protection features including but not limited to water sources, pumps, and hydrants.

b. Separation Between Buildings on the Same Lot – The separation between all structures protected by approved fire sprinkler systems and all detached, non-sprinkler protected structures, including accessory buildings, shall be a minimum of 50 feet.

c. Driveways to Structures – To allow for emergency vehicle access to structures, the property owner shall provide a driveway meeting the following requirements as approved by the FPAHJ: a minimum unobstructed driving surface of 12 feet for driveways less than 300 feet long and a 16 foot driving surface for any driveway over 300 feet long; a vertical clearance of 15 feet; and a four foot zone of reduced vegetation on each side of the driving surface. If a driveway that is less than 16 feet wide is approved by the FPAHJ, turnouts shall be designed and constructed every 300 feet along the driveway's length.

(i.) For all buildings or structure sites on driveways over 300 feet in length, the property owner shall provide a turnaround including but not limited to a drive-through, cul-de-sac or hammerhead turn-a-round.

- A turnaround shall be within 50 feet of the building or structure when there is no community water system with fire hydrants.

- A turnaround shall be within 150 feet when there is a community water system with fire hydrants.

(ii.) All gates, bridges, culverts, cattle guards and all related constructs affecting access shall be a minimum of two feet wider on each side of the driveway. The entire driveway shall have a 30-ton minimum rating for two-axle trucks including all bridges, culverts, cattle guards and all other constructs of the driveways.

1.7 Alternative Fire Protection Features or Systems – Alternative fire protection technologies, means, features or systems may be approved by the FPAHJ where they provide fire protection equivalent to or greater than required in this Appendix.

1.8 Addressing Posted – Addressing on the building shall be contrasting on the building and reflective on the street. Number size shall be four-inch (4'') minimum height. Sign numbers and the background shall be made of retro-reflective material. Address signs shall meet the requirements of the FPAHJ.

1.9 Fire Apparatus Access – Fire apparatus shall be able to park on a roadway, driveway, or fire apparatus parking area within 150 feet of all parts of the exterior of the building. The roadway, driveway, or fire apparatus parking area shall be engineered and constructed to safely support a 30-ton, two-axle fire apparatus.

1.10 Mapping – A map or electronic file, in the format approved by the FPAHJ, of the subdivision shall be provided to the FPAHJ indicating streets, addresses, street names, fire protection features, lot lines, building envelopes, utilities, easements, etc.

1.11 Fire Protection Water Supply Feature Standards – All fire protection water supply features shall meet or exceed the appropriate fire protection standard adopted by the Gallatin County Fire Council, which are based on the current edition of the Fire Code, as adopted by the State of Montana.

1.12 Travel Routes to Fire Protection Water Supply Features – Travel routes to fire protection water supply features shall be approved by the FPAHJ.

1.13 Fire Protection Sprinkler/Fire Alarm System Project Tracking Process – Fire protection sprinkler/fire alarm project tracking process may be required, by the FPAHJ, where a structure has a fire protection sprinkler system installed as a part of a subdivision fire protection plan. The tracking process may be administered by the FPAHJ. The tracking process requirements are as follows:

a. The property owner shall provide 14-day written notice of intent to build a structure with fire protection sprinkler system, and where applicable, fire alarm system, engineered by a PE. A plans review fee will be paid by the subdivider/owner to the FPAHJ. A fee schedule shall be determined by the FPAHJ. In lieu of a plans review fee and at the discretion of the FPAHJ, the FPAHJ may require a third-party review (selected by the FPAHJ) of the plans at the expense of the subdivider/property owner.

b. The property owner shall provide written certification by a PE that the fire protection sprinkler system and, where applicable, fire alarm system, are installed and fully operational prior to enclosure with sheet rock or interior wall covering installation. The FPAHJ shall be permitted to witness the testing with a minimum of 48 hours advanced notice.

c. The subdivider or property owner shall provide written certification, to the FPAHJ, by a PE and the subdivider or property owner that all fire protection requirements have been met prior to final occupancy. The FPAHJ shall be permitted to witness the checklist inspections required in this section. The subdivider or property owner shall provide the FPAHJ with 48 hours notice of the checklist inspections.

d. Occupancy shall be permitted only when all fire protection requirements have been met as determined by the FPAHJ.

1.14 Back-Up-Power Requirements for Water Distribution Systems Providing Fire Protection Water Supply:

a. Back-up power is required for water distribution systems supplying a fire hydrants or fire sprinkler systems for the wells and/or pumps if there is not any storage tanks or ponds as part of the system. The subdivider/property owner shall provide, at their expense, a back up power supply and automatic transfer switching system for the fire protection water supply system that supplies the fire sprinkler systems in the buildings and hydrants. The back up power supply system shall be engineered by a P.E. licensed in Montana. The P.E. designing back up power system shall certify in writing that the back up power supply system will be capable for the duration of the capacity of the water supply. Documentation of the proposed back up power supply system shall be provided to the FPAHJ 30 days prior to final plat approval. The back up power system design documentation shall include certification of the system capacity and design by signature of the P.E. licensed in Montana. Prior to installation, the back up power sources and automatic transfer switching systems shall meet the requirements of, and be approved by, the FPAHJ. The subdivider may be required to pay for an independent validation review of the fire protection water system back up power system they propose to the FPAHJ by a P.E. licensed in Montana and selected by the FPAHJ.

b. Back-up power, meeting the requirements of Section 1.14(a) of Appendix I, or a draft connection, meeting requirements of the FPAHJ, is required for water distribution systems supplying a fire hydrants, or fire sprinkler systems for the wells and/or pumps if there are storage tanks or ponds as part of the system.

1.15 Subdivisions with mixed residential and commercial use or buildings shall have fire protection requirements using portions (residential, commercial, etc.) of these fire protection requirements that addresses the uses (residential, commercial, etc.) for the subdivision.

1.16 A Vegetation Management Plan is required for all subdivisions that have any Common Space, Open Space or Parkland. See Section 7.1(d) of Appendix I.

2. Fire Protection Requirements for Major Residential Subdivisions (49 or less lots/units). For major residential subdivisions, the subdivider/property owner shall provide one of the following fire protection packages:

2.1 Fire protection water supply system capable of 1,000-gallons-per-minute at 20 psi minimum through an approved public water system with fire hydrants(s), for a minimum of 120 minutes. The distribution of fire hydrants shall meet the requirements of the current edition of the Fire Code, as adopted by the State of Montana; or

2.2 Fire protection water tank(s), constructed from plastic, concrete, fiberglass or other materials, approved by the FPAHJ. The capacity of the tanks shall be a minimum of 30,000 gallons with a pump capable of delivering 1,000-gallons-per-minute at 20 psi from an approved fire hydrant. The maximum travel distance to the edge of the lot line furthest from a hydrant on a route approved by the FPAHJ shall be 1,000 feet. The tank(s) shall have an automatic water supply to maintain the required capacity; or

2.3 Installation in every residential or combination use structure, a fire protection sprinkler system. The Fire Sprinkler System shall be connected to a public water supply, if available and the system shall be engineered by an licensed engineer (P.E.), installed and fully operational and compliant with the current edition of the applicable NFPA standard and one of the following fire protection water supply packages:

a. Fire protection water tank(s), or ponds, of 30,000-gallon capacity with a pump capable of delivering 500-gallons-per-minute at 20 psi from an approved fire hydrant with a maximum approved travel distance from the furthest edge of the lot line from the hydrant to tank of 5,000 feet. The tank(s) shall have an automatic water supply to maintain the required captivity. Back-up power or a draft connection is also required; or

b. Fire protection water supply system capable of 500-gallons-per-minute at 20 psi minimum through an approved public water system with fire hydrants, for 120 minutes. Fire hydrants shall be installed no more than 1000-foot intervals.

3. Fire Protection Requirements for Major Residential Subdivisions (50 or more lots/units). For major residential subdivisions, the subdivider/property owner shall provide one of the following fire protection packages:

3.1 Fire protection water supply system capable of 1,000-gallons-per-minute at 20 psi minimum through an approved public water system with fire hydrants(s), for a minimum of 120 minutes. The distribution of fire hydrants shall meet the requirements of the current edition of the Fire Code, as adopted by the State of Montana; or

3.2 Installation in every residential or combination use structure, a fire protection sprinkler system. The Fire Sprinkler System shall be connected to a public water supply and the Fire Sprinkler System shall be engineered by an licensed P.E., installed and fully operational and compliant with the current edition of the applicable NFPA standard and one of the following fire protection water supply packages:

a. Fire Protection Water Supply system capable of 1000-gallons-per-minute at 20 psi minimum, through an approved public water system, with fire hydrants, for 60 minutes. Fire hydrants shall be installed no more than 1000-foot intervals; or

b. Fire protection water supply system capable of 500-gallons-per-minute at 20 psi minimum, through an approved public water system, with fire hydrants, for 120 minutes. Fire hydrants shall be installed no more than 1000-foot intervals.

4. **Fire Protection Requirements for One Lot Minor Residential Subdivisions**. For a one (1) lot minor residential subdivision, the subdivider/property owner shall provide one of the following fire protection packages:

4.1 An underground tank or pond of 10,000 gallons capable of delivering 1,000-gallons-per-minute from an approved fire hydrant with a maximum approved travel distance from the furthest lot line to the hydrant of 1,000 feet; or

4.2 Installation in every residential or combination use structure a fire protection sprinkler system. The Fire Sprinkler System shall be connected to a public water supply, if available and the system shall be engineered by a licensed P.E., installed and fully operational and compliant with the current edition of the applicable NFPA standard.

5. **Fire Protection Requirements for Two-through Five-Lot Minor Residential Subdivisions**. For a two-to five-lot minor residential subdivision, the subdivider/property owner shall provide one of the following fire protection packages:

5.1 A storage tank(s) or pond of 30,000 gallons with a pump capable of delivering 1,000-gallons-per-minute at 20 psi from an approved fire hydrant. The maximum approved travel distance from the lot most distant from the hydrant to the hydrant shall be 1,000 feet. The tank(s) shall have an automatic water supply to maintain the required capacity. The tank(s) can be underground, on the ground, or elevated; or

5.2 Installation in every residential or combination use structure, a fire protection sprinkler system. The Fire Sprinkler System shall be connected to a public water supply, if available and the system shall be engineered by an licensed P.E., installed and fully operational and compliant with the current edition of the applicable National Fire Protection A standard and one of the following fire protection water supply packages:

a. Storage tank or pond of 10,000-gallon capacity with a pump capable of delivering 500-gallons-per-minute at 20 psi from an approved fire hydrant with a maximum approved travel distance from the furthest edge of the lot line from the hydrant to tank of 5,000 feet; or

b. Fire protection water supply system capable of 1,000-gallons-per-minute from draft through an approved fire hydrant system, for 120 minutes. Maximum travel distance from the edge of the lot line furthest from the hydrant to the tank, on a route approved by the FPAHJ, shall be 5,000 feet.

6. **Fire Protection Requirements for Commercial Subdivisions and Buildings.** Commercial buildings and buildings which are used for purposes other than as dwellings or as lodging houses which accommodate 10 persons or less shall provide the following fire protection features:

6.1 Each commercial structure that is required to provide fire detection and/or fire protection sprinkler systems, shall have installed a lock box to hold keys to the exterior and interior doors. The lock box make and model, and the location shall be approved by the FPAHJ. The lock box shall contain current contact information for a local, responsible party or parties who will respond to fire alarms or fire sprinkler system alarms.

6.2 A fire protection water supply shall be provided that meets or exceeds the minimum required fire flow and flow duration for buildings as described in the current edition of the Fire Code, as adopted by the State of Montana.

6.3 All commercial structures that are required to provide fire detection and/or fire protection sprinkler systems, either by code or as part of the Fire Protection Plan, shall have the plans reviewed and approved by the FPAHJ. These systems shall comply with the current edition of the Fire Code, as adopted by the State of Montana, for design and installation.

6.4 Structures with fire protection sprinkler systems shall be allowed to have a minimum of one (1) approved fire hydrant delivering 1000-gallons-per-minute at 20 psi for 2 hours at a maximum travel distance of 5,000 feet to the furthest lot line on an FPAHJ-approved route.

6.5 Fire hydrant locations and distribution – Fire hydrants shall be provided in accordance with the current edition of the Fire Code, as adopted by the State of Montana. Locations and distribution shall be reviewed and approved by the FPAHJ before construction.

a. Consideration of existing fire hydrants – Existing fire hydrants on public streets are allowed to be considered as available. Existing fire hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extend between properties and easements are established to prevent obstruction of such roads.

6.6 All structures shall be built meeting or exceeding the requirements of the current editions of the Fire and Building codes, as adopted by the State of Montana.

7. WILDLAND/URBAN INTERFACE :

For areas identified as Wildland/Urban Interface in the Gallatin County Community Wildfire Protection Plan (CWPP) or by the United States Forest Service, Montana Department of Natural Resources and Conservation, a local FPAHJ, a local growth policy, special standards are required.

7.1 Additional Requirements: For subdivisions proposed in areas that are classified, by the CWPP, as Wildland/Urban Interface Area or as indicated as High or Extreme Hazard by the Wildland Fire Risk and Hazard Severity Assessment Form, the following standards shall apply:

a. Water Supply - An additional 500-gallons-per-minute shall be included in the base fire flow requirement.

b. Access and Evacuation -

(i.) Road rights-of-way shall be cleared of construction slash. The required clearance of the right-of-way shall be maintained, in perpetuity, in a fire-resistive state.

(ii.) All bridges and cattle guards shall be constructed of noncombustible materials.

(iii.) Subdivisions shall be designed to allow emergency vehicle access to wildland areas behind structures by:

- o Providing a perimeter roadway approved by FPAHJ along the entire wildland side of a development; or by
- o Providing a fuel break that has been reviewed and approved by the FPAHJ, and accessible to fire apparatus.

  - ▪ Building Density Requirements - Densities in areas of steep slopes and/or dense forest growth shall be appropriate per the site conditions.

  - ▪ Vegetation Management - A vegetation management plan shall be submitted for review and approval of the FPAHJ.

    - Intent - The intent of the vegetation management plan is to:

- o Reduce fuel loading and hazard rating and provide continuous maintenance of the fuel load.

- To protect life and property.

- To reduce the potential for a fire on improved property from spreading to wildland fuels and from a fire in wildland fuels from spreading to the structures.

- To provide a safe working area and access for emergency responders.

    - Components – Vegetation management plans shall describe all actions that will be taken to prevent a fire from being carried toward or away from the development. A vegetation management plan shall include at least the following information:

- A copy of the site plan for the development.

- Methods and timetables for controlling, changing or modifying areas on the property. Elements of the plan shall include removal of slash, snags, vegetation that may grow into overhead electrical lines, other ground fuels, ladder fuels, and dead trees, and the thinning of live trees.

- A plan for continuously maintaining the proposed fuel-reduction measures.

- Establishment of the requirements for defensible space as appropriate per site conditions and as described in the following section.

e. Defensible Space - Provisions of this section are intended to modify the fuel load in areas adjacent to structures to create a defensible space.

- Fuel Load Reduction - The dimensions of the defensible space shall be based upon the requirements established in the Vegetation Management Plan.

- Ground Fuel - Ground fuel within the defined defensible space, shall be treated (mowed, mulched, converted to compost, etc.) or removed annually or more frequently as directed by the FPAHJ.

- Thinning and Pruning - Live vegetation within the defensible space shall have all dead material removed and shall be thinned and pruned to reduce fire intensity and rate of spread.

- Dead Trees - Dead trees within the defensible space of buildings shall be removed.

- Ladder Fuels - Vegetation under trees, within the defined defensible space, shall be maintained at a height that will preclude its functioning as a "ladder" for fire to travel from ground vegetation into the tree crown.

- Fire-Resistant Landscaping - Where landscaping is desired, the proposed vegetation type and/or management practices shall be approved by the FPAHJ and be in compliance with fire resistant landscaping guidelines.

- Defensible Space Maintenance - The defensible space plan shall include a maintenance element with the responsibility for maintenance defined.

o Fuel Breaks & Greenbelts - Open space, park land and recreation areas (including greenbelts, riding or hiking trails) should be located, where appropriate, to separate communities, groups of structures, or residences and other buildings from densely forested areas. These breaks can slow or stop the spread of an oncoming wildland fire.

- Fuel Breaks & Greenbelts Required - If the FPAHJ determines it is necessary to reduce the threat of wildland fires to life or improved property, fuel modification outside of the defensible space shall be required.

- Fuel Breaks & Greenbelt Maintenance - The vegetation management plan shall include a maintenance element with the responsibility for maintenance of the fuel breaks and greenbelts defined.

8. WILDLAND/URBAN INTERFACE FIRE PROTECTION COVENANTS

All covenants required to meet the fire protection requirements shall be recorded consistent with the Subdivision Regulations. The County Commission shall consult the FPAHJ prior to adoption or amendment of the fire protection covenants. The FPAHJ is granted standing in the covenants of the subdivision for the purposes of enforcing all fire protection requirements. A fire protection note calling attention to the fire protection requirements, approved by the FPAHJ, shall be placed on the final plat.

8.1 Covenants: The following covenants may be included as a requirement of the Fire Protection Plan to mitigate potential threats from fire:

a. Maintenance of Fire Protection Water Supply (for example: water systems, draft sites, fill sites, buried tanks or open ponds) – Fire protection water supplies must be maintained to their original performance capability in perpetuity by the property owners. Performance of all fire protection features shall be certified annually by a licensed P.E. and submitted to the FPAHJ to ensure continued specified capability.

b. Maintenance of Fire Protection Features (for example: defensible spaces, Driveway routes, fuel breaks, fuel modification plan, greenbelts, etc.) - Fire protection features must be maintained to their original performance capability in perpetuity by the property owners.

c. In the event that automatic sprinkler systems are an acceptable alternative for fire protection, as approved by the FPAHJ, the requirements of installation shall be included in an agreement with the local fire protection authority which shall be filed with the plat.

9. Definitions.

a. Accessory Building or Structure. Any building or structure used incidentally to another building or structure.

b. Address Identification Signs. Signs displaying the numeric address(as approved by Gallatin County GIS) of the structure. Address signs shall meet the requirements of the FPAHJ.

c. Alternative. A system, condition, arrangement, material, or equipment submitted to the Fire Protection Authority Having Jurisdiction (FPAHJ) as a substitute for a code requirement.

d. Approved. Acceptable to the Fire Protection Authority Having Jurisdiction.

e. Aspect. Compass direction toward which a slope faces.

f. Building. Any structure used or intended for supporting any occupancy.

g. Combustible. Any material that, in the form in which it is used and under the conditions anticipated, will ignite and burn (see Noncombustible).

h. Community Wildland Protection Plan (CWPP). Community Wildfire Protection Plans are authorized and defined in Title I of the Healthy Forests Restoration Act (HFRA) passed by Congress on November 21, 2003 and signed into law by President Bush on December 3, 2003.
The Healthy Forests Restoration Act places renewed emphasis on community planning by extending a variety of benefits to communities with a wildfire protection plan in place. Critical among these benefits is the option of establishing a localized definition and boundary for the wildland-urban interface (WUI) and the opportunity to help shape fuels treatment priorities for surrounding federal and non-federal lands.
The CWPP, as described in the Act, brings together diverse local interests to discuss their mutual concerns for public safety, community sustainability and natural resources. It offers a positive, solution-oriented environment in which to address challenges such as: local firefighting capability, the need for defensible space around homes and subdivisions, and where and how to prioritize land management – on both federal and non-federal land.

i. Defensible Space. An area as defined by the FPAHJ, between an improved property and a potential wildland fire where the combustibles have been removed or modified with the following intent:

(1) To protect life and property from wildland fire.

(2) To reduce the potential for fire on improved property spreading to wildland fuels.

(3) To provide a safe working area for fire fighters protecting life and improved property.

j. Dry Hydrant. An arrangement of pipe permanently connected to a year around water source other than a piped, pressurized water supply system that provides a ready means of water supply for firefighting purposes and that utilizes the drafting (suction) capability of fire department pumpers. The point of connection between the water source and the fire department pumper shall be a fire hydrant approved by the FPAHJ.

k. Dwelling. One or two living units, each providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

l. Evacuation. The temporary movement of people and their possessions from locations threatened by a hazard.

m. Fire Hydrant. A valved connection on a piped year around pressured water supply system having one or more outlets that is used to supply hose and fire department pumpers with water.

n. Fire Lane. A means of access or other passageway designated and identified to provide access for emergency apparatus where parking is not allowed.

o. Fire Protection Authority Having Jurisdiction (FPAHJ). The organization, office, or individual responsible for approving equipment, an installation, or a procedure and having jurisdiction (as established by action described in, and in accordance with, Montana Codes Annotated).

p. Fire Resistant Landscaping. Vegetation management which removes flammable fuels from around a structure, and access routes to the structure, to reduce exposure to radiant heat. The flammable fuels maybe replaced with green lawn; gardens; certain individually spaced, green, ornamental shrubs; individually spaced and pruned trees; decorative rock or stone; or other non-flammable or flame resistant materials.

q. Fire Resistive or Fire Resistive Construction. Construction to resist the spread of fire, details of which are usually found in the currently adopted edition of the Uniform Building Code or others building code or codes as use by the FPAHJ.

r. Fuel Break. An area, strategically located for fighting anticipated fires, where the native vegetation has been permanently modified or replaced so that fires burning into it can be more easily controlled. Fuel breaks divide fire-prone areas into smaller areas for easier fire control and to provide access for fire fighting.

s. Fuel Hazard Rating. A measure of the fire behavior and the difficulty of fire control in non-fire-resistive materials. At the discretion of the FPAHJ, applicable references may include, but are not limited to, those available from DNRC, NFPA, and others.

t. Fuel Loading. The volume of fuel in a given area generally expressed in tons per acre.

u. Fuel Modification. Any manipulation or removal of fuels to reduce the likelihood of ignition or the resistance to fire control.

v. Fuels. All combustible material within the wildland/urban interface, including vegetation and structures.

w. Greenbelt. An area with fire-resistive vegetation (planted or native), maintained to cause a reduction in fire intensity, and used for other than fire protection (golf course, cemetery, park, playground, mowed park, orchard, etc.).

x. Ground Fuels. All combustible materials such as grass, duff, loose surface litter, tree or shrub roots, rotting wood, leaves, peat, or sawdust that typically support combustion.

y. Hammerhead "T". A roadway that provides a "T"-shaped, three-point turnaround for emergency equipment that is no narrower than the road that it serves. The top of the "T" shall be a minimum of 40 ft (12.19 m) long in each direction (see Turnaround).

z. Hazard. A fuel complex defined by kind, arrangement, volume, condition, and location, that determines the ease of ignition and/or of resistance to fire control.

aa. Ladder Fuels. Fuels that provide vertical continuity allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease.

bb. Life Risk. Events, actions, or situations created by emergency incidents that have the potential to cause serious injury or death to people.

cc. Life Safety. Actions taken to prevent the endangerment of people threatened by emergency incidents or by activities associated with the management.

dd. Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the Fire Protection Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

ee. Mitigation. Action that moderates the severity of a fire hazard or risk.

ff. Noncombustible. A material that, in the form in which it is used and under the conditions anticipated, will not aid combustion or add appreciable heat to an ambient fire.

gg. One-Lot Subdivision. The subdivision of an existing parcel of land that creates only one new lot, where the remainder parcel is 160 acres or greater.

hh. Professional Engineer (PE). An engineer licensed in Montana and approved by the FPAHJ.

ii. Public-Access Easement. A thoroughfare that has been dedicated for public use.

jj. Rated Roof. A roof constructed with a "roof covering assembly" that is listed as meeting the requirements for Class A, B, or C "roof covering assembly materials" as determined by the FPAHJ. At the discretion of the FPAHJ, applicable references may include, but are not limited to, NFPA and other codes or listing authorities.

kk. Roadway. An open way for passage of vehicles giving access to more than one parcel.

ll. Shall. Indicates a mandatory requirement.

mm. Should. Indicates a recommendation or that which is advised but not required.

nn. Shoulder. Surface of a road adjacent to the traffic lane.

oo. Slope. Upward or downward incline or slant, usually calculated as a percent of slope [rise or fall per 100 ft (30.45 m) of horizontal distance].

pp. Street or Road Identification Signs. Any sign containing words, numbers, directions, or symbols that provides information to emergency responders.

qq. Structure. That which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

rr. Traffic Lane. That portion of a roadway that provides a single lane of vehicle travel in one direction.

ss. Turnaround. A portion of a roadway, unobstructed by parking, that allows for a safe reversal of direction for emergency equipment.

tt. Turnouts. A widening in a travel way of sufficient length and width to allow emergency vehicles to pass one another.

uu. Vegetation Management Plan. A vegetation management plan reduces the amount of fuel available for wildland fires, reducing the probability of a rapidly spreading wildland fire. Elements of the plan include removal of slash, snags, other ground fuels, ladder fuels and dead trees, and thinning of live vegetation.

vv. Water Supply. A source of water for fire fighting activities.

ww. Wildland Fire. An unplanned and uncontrolled fire spreading through vegetative fuels, at times involving structures.

xx. Wildland/Urban Interface (or Structure-Wildland Interface). An area where improved property and wildland fuels are both present.

Appendix 1 - WILDLAND FIRE RISK AND HAZARD SEVERITY ASSESSMENT FORM

Assign a value to the most appropriate element in each category and place the number of points in the column on the right.

Element		**Points**
A. Means of Access		
1. Ingress and Egress		
a. Two or more roads in/out	0	______________
b. One road in/out	7	______________
2. Road Width		
a. ≥7.3 m (24 ft.)	0	______________
b. ≥6.1 m (20 ft) and <7.3 m (24 ft).	2	______________
c. <6.1 m (20 ft)	4	______________
3. All-Season Road Condition		
a. Surfaced road, grade <5%	0	______________
b. Surfaced road, grade >5%	2	______________
c. Non-surfaced road, grade <5%	2	______________
d. Non-surfaced road, grade >5%	5	______________
e. Other than all-season	7	______________
4. Fire Service Access		
a. ≤91.4 m (300 ft.) with turnaround	0	______________
b. >91.4 m (300 ft) with turnaround	2	______________
c. <91.4 m (300 ft) with no turnaround	4	______________
d. ≥91.4 m (300 ft) with no turnaround	5	______________
5. Street Signs		
a. Present {10.2 cm (4 in.) in size and reflectorized}	0	______________
b. Not present	5	______________
B. Vegetation (Fuel Models)		
1. Characteristics of Predominate Vegetation Within 91.4 m (300 ft.)		
a. Light (e.g., grasses, forbs, sawgrasses, and tundra) NFDRS Fuel Models A, C, L, N, S, and T	5	______________
b. Medium (e.g., light brush and small trees) NFDRS Fuel Models D, E, F, H, P, Q, and U	10	______________
c. Heavy (e.g., dense brush, timber, and hardwoods) NFDRS Fuel Models B, G, and O	20	______________
d. Slash (e.g., timber harvesting residue) NFDRS Fuel Models J, K, and L	25	______________
2. Defensible Space		
a. More than 30.48 m (100 ft) of vegetation treatment from the structure(s)	1	______________
b. 21.6 m to 30.48 m (71 ft. to 100 ft.) of vegetation treatment from the structure(s)	3	______________
c. 9.14 m to 21.3 m (30 ft. to 70 ft.) of vegetation treatment from the structure(s)	10	______________
d. <9.14 m (30 ft.) of vegetation treatment from the structure(s)	25	______________
C. Topography Within 91.4 m (300 ft.) of Structure(s)		
1. Slope <9%	1	______________
2. Slope 10% to 20%	4	______________
3. Slope 21% to 30%	7	______________
4. Slope 31% to 40%	8	______________
5. Slope >41%	10	______________

WILDLAND FIRE RISK AND HAZARD SEVERITY ASSESSMENT FORM (continued)

Element	Points	
D. Additional Rating Factors (rate all that apply)		
1. Topographical features that adversely affect wildland fire behavior	0-5	________
2. Areas with a history of higher fire occurrence than surrounding area due to special situations (e.g., heavy lightning, railroads, escaped debris burning, and arson)	0-5	________
3. Areas that are periodically exposed to unusually severe fire weather and strong dry winds	0-5	________
4. Separation of adjacent structures that can contribute to fire spread	0-5	________
E. Roofing Assembly		
1. Class A Roof	0	________
2. Class B Roof	3	________
3. Class C Roof	15	________
4. Non-rated	25	________
F. Building Construction		
1. Materials (predominate)		
a. Noncombustible/fire-resistive siding, eaves, and deck (see Chapter 8)	0	________
b. Noncombustible/fire-resistive siding and combustible deck	5	________
c. Combustible siding and deck	10	________
2. Building Setback Relative to Slopes of 30% or More		
a. >9.14 m (30 ft.) to slope	1	________
b. <9.14 m (30 ft) to slope	5	________
G. Available Fire Protection		
1. Water Source Availability		
a. Pressurized water source availability		
1892.7 L /min (500 gpm) hydrants ≤304.8 m (1000 ft) apart	0	________
946.4 L/min (250 gpm) hydrants ≤304.8 m (1000 ft.) apart	7	________
b. Non-pressurized water source availability (off site)		
≥946.4 L/min (250 gpm) continuous for 2 hours	3	________
<946.4 L/min (250 gpm) continuous for 2 hours	5	________
c. Water Unavailable	10	________
2. Organized Response Resources		
a. Station ≤8 km (5 mi.) from structure	1	________
b. Station >8 km (5 mi.) from structure	3	________
3. Fixed Fire Protection		
a. NFPA 13, 13R, 13D sprinkler system	0	________
b. None	5	________
H. Placement of Gas and Electric Utilities		
1. Both underground	0	________
2. One underground, one above ground	3	________
3. Both above ground	5	________
I. Totals for Home or Subdivision (Total of all points)		[ ]

Hazard Assessment	Total Points
Low Hazard	<40
Moderate Hazard	40 – 69
High Hazard	70 -112
Extreme Hazard	>112

TABLE 1: Fire Protection Water Supply Options by Type of Residential Subdivisions

Type of Residential Subdivision	**Fire Protection Water Supply Options** (as described in Table 2 below)
Major Subdivision (49 or less lots/units)	Select from one of the following options: i. A ii. E iii. I and either D or F
Major Subdivision (50 or more lots/units)	Select from one of the following options: i. A ii. I and either B or D
Minor Subdivision (1 lot/unit)	Select from one of the following options: i. G ii. I
Minor Subdivision (2 to 5 lots/units) * See also Section 5 of Appendix I.	Select from one of the following options: i. E ii. I and either H or C
Note: Specific details for each option are described in Table 2 below and within the text of Sections 2–5 of Appendix I. In accordance with the content of Appendix I, further requirements may apply depending on the specifics of the project (size of lots, location within the Wildland/Urban Interface, mixed-use development, etc.). The Fire Protection requirements for commercial subdivisions are described in Section 6 of Appendix I.	

TABLE 2: Summary of Fire Protection Water Supply Options for Residential Subdivisions.

Option	**Means of Protection**	**Water Tank Size (Gallons)**	**Flow (gpm)**	**Duration of Flow (Minutes)**	**Hydrant Spacing (Feet)**	**Travel Distance (Feet)**	**Standard**
A	Public Water Supply		1,000 @ 20 psi	120	Per Fire Code		Per Fire Code
B	Public Water Supply		1,000 @ 20 psi	60	< 1000		P.E.
C	Water Supply		1,000 @ draft	120		< 5,000	P.E.
D	Water Supply		500 @ 20 psi	120	< 1000		P.E.
E	Water Storage Tank or Pond	30,000	1,000 @ 20 psi			< 1,000	P.E.
F	Water Storage Tank or Pond	30,000	500 @ 20 psi			< 5,000	P.E.
G	Water Storage Tank or Pond	10,000	1,000 @ draft			< 1,000	P.E.
H	Water Storage Tank or Pond	10,000	500 @ 20 psi			< 5,000	P.E.
I	Automatic Fire Sprinklers						P.E. & NFPA

6. E. Fire Protection Requirements.

Fire Protection Requirements for subdivisions are described in this Section (Section 6.E) and Appendix I (Fire Protection Packages). Appendix I is adopted as part of these Regulations. All subdivisions shall be required to provide the following fire protection measures:

1. Fire Protection Plan. All proposed subdivisions shall provide a Fire Protection Plan approved by the local Fire Protection Authority Having Jurisdiction (FPAHJ) prior to the subdivision application being considered complete by the Planning Department. The FPAHJ is the Fire Chief of the fire service organization providing fire protection services to the proposed subdivision. The Fire Protection Plan shall include the following:

   a. Description and confirmation of fire protection service/arrangement as required under Section 6.E.2.

   b. For all subdivisions, compliance with general fire protection requirements as outlined under Section 1 of Appendix I, General Fire Protection Requirements.

   c. For major residential subdivisions, fire protection packages as outlined under sections 2 and 3 of Appendix I.

   d. For one-lot minor residential subdivisions, fire protection packages as outlined under Section 4 of Appendix I.

   e. For two through five-lot minor residential subdivisions, fire protection packages as outlined under Section 5 of Appendix I.

   f. For commercial subdivisions and buildings, fire protection packages as outlined under Section 6 of Appendix I.

   g. For subdivisions identified as being located within a Structure- Wildland Interface by the Gallatin County Community Wildfire Protection Plan and the FPAHJ, compliance with fire protection requirements for subdivisions in Structure-Wildland Interface as outlined under Section 7 of Appendix I.

2. Fire District/Service Area. If a subdivision is not located in a fire district or fire service area, one of the following fire protection arrangements shall be provided:

   a. If contiguous to a fire district or fire service area, the subdivision shall petition to annex into the fire district or fire service area before preliminary plat application.

   b. If the annexation is unsuccessful, the subdivider/property owner(s) shall either:

      i) contract for fire protection services from an existing rural fire district or fire service area ; or
      ii) form a new fire district or fire service area and contract with an existing rural fire district or fire service area for all Fire Protection Services**;** or
      iii) form a rural fire district or fire service area meeting the criteria listed in the Gallatin County Fire Council Fire Protection Standard for New Rural Fire Districts and Fire Service Areas.

3. Fire Protection Review Fees. All subdivisions that are located in or annex into a fire district or fire service area shall pay the Fire Protection Review Fee per the current fee schedule on file with the Planning Department.

4. Proportionate Reimbursement: If additional subdivisions will be served by an existing Fire Protection Water Supply, the Commission shall include reimbursement of the original Fire Protection Water Supply improvement costs as a condition of preliminary approval of any additional subdivision.

   The proportionate reimbursement shall be determined based on the ratio of the number of lots in the subdivision to the total number of lots served by the Fire Protection Water Supply. The ratio then is multiplied by the total cost of the Fire Protection Water Supply. The new subdivision shall join the entity that is responsible in the maintenance or improvements of the Fire Protection Water Supply. If the total cost of the Fire Protection Water Supply has been reached, then a fee of not less that $100 per lot/living unit shall be paid to the entity that is responsible for maintenance or improvements of the Fire Protection Water Supply.

5. Reimbursement Methodology: The original subdivider/property owner shall forward the total costs of improvements to the Planning Department within 60 days of the completion of improvements. Subsequent subdivisions shall pay their proportionate reimbursement to the Planning Department. The Planning Department shall then make disbursements within 60 days of receiving reimbursement funds. Funds shall be disbursed to the entity which has the responsibility for maintenance of the facility. Documentation should also be given to the FPAHJ regarding cost of the improvements.

Gallatin County
Community Wildfire Protection Plan