

Community Wildfire Protection Plan

For the Cities of

Bingen and White Salmon

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Executive Summary

This Community Wildfire Protection Plan covers the cities of Bingen and White Salmon and the area west of White Salmon to the White Salmon River. The purpose of the plan is to identify and assess wildfire hazards, wildfire risk factors, and to develop a strategy to reduce the potential for wildfire damage in the planning area. Major findings of the planning process are:

- More than one-third of the planning area (825 acres) is classified as forest with a heavy fuel load. Underbrush is often thick providing a ladder fuel effect which would help fire reach into the crowns of the larger trees. Much of this forested area occurs in relatively large blocks of land with few effective fuel breaks.
- The bluff area above Highway 14 presents a dangerous situation for residents living above. Heavy fuels coupled with steep slopes, frequent high winds and hot/dry summer conditions exist along the bluff from the White Salmon River east to Bingen.
- About 35 percent of the planning area has slopes of 30 percent or greater. Most of this area has heavy fuel loads.
- There are serious wildfire risk factors in the planning area: the railroad and Highway 14 at the base of the bluff area, fireworks, lightning, power lines, debris burning, discarded cigarettes, and house fires.
- Creating a defensible space around their home is the most important action a homeowner can take to improve the odds of saving their home during a wildfire event.
- Most homes within the planning area need some form of fuel treatment to make them more fire-resistant during a wildfire.
- Many homes have construction material which would make them vulnerable in a wildfire situation.
- Some residential areas are served by only one means of access presenting serious limitations for escape during a wildfire emergency.

Several action items, or projects, designed to reduce wildfire hazards are presented. One large project with several segments targets the bluff area. The intent is to reduce the fuel load throughout the bluff area while providing a more defensible space along Highway 14 and along the top of the bluff. Other projects address the compartmentalization of fuel blocks, access limitations, and the creation of defensible space for individual homes and developments.

This plan offers advice to homeowners and local officials on how to make the planning area less vulnerable to wildfires. While most of the hazard reduction work would be accomplished on private land, the plan does not mandate property owners to do anything. Some of the strategy presented would be accomplished with available public funding and some would be done by individuals taking responsibility for the work on their property. Much of the strategy would require the permission of property owners before it could be accomplished.

I. Introduction

This Wildfire Protection Plan for the Cities of White Salmon and Bingen was prepared through a Title III grant from Klickitat County. The planning process was designed to meet the guidance in the National Fire Plan and the Healthy Forest Restoration Act of 2003 (HR 1904). The primary purpose for the plan is to provide information to property owners and city officials within the planning area which will provide them an opportunity to be better prepared for a wildfire event, if and when it occurs. The plan identifies high risk areas and individual parcels that would be vulnerable during a wildfire occurrence. It offers strategies and methods designed to reduce the potential loss of property values and threat to human life from wildfires.

The Cities of White Salmon and Bingen, along with their surrounding areas, represent a classic example of a Wildland Urban Interface situation with strong potential for a catastrophic wildfire event that could destroy high value properties and threaten human life. The following conditions are found throughout, or in certain portions of, the planning area. Some areas have all, or most, of these conditions:

- Steep slopes, some in excess of 60 percent.
- High wind situations (Columbia River Gorge conditions) during much of the fire season.
- Light flashy fuels consisting of brush and, or, uncut grass.
- Heavy fuel loads of mature conifer and hardwood trees with brush underneath.
- Access problems including one means of ingress and egress, narrow drives, and turning radius limitations.
- High value homes.
- Homes with no, or very limited, defensible space.
- Numerous homes with combustible construction materials, i.e. shake roofs, cedar siding, wood decks.

The planning area has experienced numerous wildfires in recent years. Fortunately, suppression efforts have been successful in preventing a catastrophic fire event resulting in the loss of homes or life. However, conditions exist for the type of wildfire event which could destroy many homes and threaten lives. Each year this situation becomes worse as additional people move into the area and vegetation becomes denser. Community leaders recognize the problem and wish to take action to limit the potential for a wildfire with serious effects to property and human safety. While some individuals realize there is a problem, many are not aware of the situation or are not prepared enough to take action to reduce hazardous situations on their property.

The planning area for the purpose of this study involves the following:

- The City of Bingen including the urban growth boundary.
- The City of White Salmon including the urban growth boundary.

The boundary of the planning area on the west is the Highway 141 cut-off just above the White Salmon River. To the south, the planning area goes to the high water mark of the Columbia River.

II. Planning Process

In the spring of 2004, the City of White Salmon received a Title III grant from Klickitat County to complete a Community Wildfire Protection Plan for the White Salmon and Bingen area. The City of White Salmon hired a contractor, Jim Hulbert, to conduct the planning process. The planning process used was patterned after the handbook for Wildland-Urban Interface Communities titled, Preparing a Community Wildfire Protection Plan. The following steps were followed:

Step one: Convene decision makers

A Core Team designed to act as an advisory committee was formed to work with the contractor. The Core Team met several times during the planning process to help establish, review and critique the planning documents. The Team consisted of representatives from the following entities:

- Cities of White Salmon and Bingen
- Klickitat County
- Washington Department of Natural Resources
- USDA Forest Service (Columbia River Gorge National Scenic Area office)
- SDS Lumber Company
- White Salmon and Bingen Fire Departments
- Interested citizens

Step two: Establish planning area boundary and planning goals

The Core Team decided early on to limit the planning area to the urban growth boundaries of the communities of White Salmon and Bingen. The planning area covers approximately 2,400 acres. It includes the Port of Klickitat County and SDS property on the south, and properties to alternate 141 on the west. Approximately ?? percent of the planning area is outside of the current city boundaries which is why it was important to include Klickitat County representation on the Core Team

The following goals for the Community Wildfire protection plan were agreed to by the Core Team:

- Provide information to homeowners and city officials on how to be better prepared for a wildfire event.
- Identify and prioritize high hazard areas and highly vulnerable home sites.
- Develop a strategy to ameliorate the threat to homeowners from wildfires.
- Make the community more competitive for available funding assistance for hazardous fuel reduction projects.

- Help support a designation for the cities as a “Community at Risk” (the City of Bingen is listed as a Community at Risk but White Salmon is not as of June, 2004).
- Involve community members in the planning process through city newsletters, the local newspaper, and one or more town hall type meetings.

The Core Team established a goal of completing the plan by October 1, 2004

Step three: Establish a Community Base Map

A community base map was developed using the GIS system developed by Klickitat County. A color orthophoto map (approximately 1 inch equals 400 feet) showing parcel boundaries was built from 2002 aerial photos. This base map was used to delineate low, moderate, and high risk zones in the planning area. It also displayed individual high risk ownership parcels.

Step Four: Hazard Risk Assessment

An assessment of wildfire risks was completed using aerial photos and field observations. The assessment was done on an area basis and for individual home sites. Hazardous fuel type and amount along with percent slope were the primary criteria used to rate risk zones. Areas with slopes of 30 percent or more were rated as high risk regardless of the fuel conditions, although these areas generally exhibited heavy fuel loads as well.

It is important to point out the various risk zones or areas are not necessarily uniform in condition. For example, within areas rated as medium, there are some portions that could be considered high risk, and some that might be called low risk. However, overall the conditions would be considered medium. The same would be true with low and high risk areas.

Criteria developed as part of the NFPA-299 survey assessment program were used to establish risk ratings for individual home sites. Dwellings associated with one or more of the following conditions were considered at high risk during a wildfire event:

- Wooden shake roof,
- Heavy vegetation touching or in close proximity to the structure,
- Steep slopes.

All dwellings located on the bluff above the Columbia River were rated as high risk because of the steep slopes and high fuels loads located in close proximity. While only high risk parcels were highlighted on the base map, most parcels had some degree of risk associated with it. Very few would be considered “fire-safe.” Overall, there was a continuum from a fire-safe condition up to a high risk situation and every property had a unique set of conditions.

Step Five: Establish Community Priorities and Recommendations

The Core Team considered the results of the hazardous fuel situation assessment and established a list of priority projects within the planning area. For each potential project, objectives were established and a strategy for achieving them was developed. The types of projects include:

- Hazardous fuel reduction measures,
- Reducing structural ignitability,
- Improving fire response capability,
- Information/education efforts directed toward individual homeowners.

Criteria used in selecting priority projects include:

- Likelihood for acceptance by property owners,
- The best chance for successful implementation,
- The best cost-benefit ratio,
- Likelihood of getting funding assistance for implementation.

After an initial selection and prioritization of projects by the Core Team, a public meeting was held to gather input from interested property owners. Using this public input, the Core Team developed final recommendations of prioritized projects for consideration and approval by respective city councils.

Step Six: Development of Action Plan.

An Action Plan was developed showing the following:

- Project priorities,
- Timeline for implementation (five year timeline),
- Responsibilities for implementation,
- Budget needs.

Step Seven: Communicate Wildland Protection Plan information to property owners.

A strategy to effectively communicate information from the plan was devised. A combination of media releases, public meetings, and handout material was designed to reach the maximum number of property owners in the planning area.

III. Community Profile

The cities of Bingen and White Salmon comprise two of only three incorporated communities in Klickitat County. The City of Bingen, incorporated in 1924, has a population of 672. It was originally established in the late 1800s as a mill-site and lumber port on the Columbia River. It is served by State Highway 14 on which much of its business district is located. Its major source of employment includes the SDS Lumber Company which employs about 230 persons and Underwood Fruit providing between

270 and 400 jobs, depending on the season. The Port of Klickitat located just outside of Bingen's city limits owns 104 acres, of which 52 are developable. Much of the city is at less than 100 feet above sea level, but the northern portion of the community rises sharply above the downtown area and includes a portion of the "bluff" leading up to the City of White Salmon.

White Salmon, incorporated in 1907, is a full service community with a population of 2,220. The City takes its name from the nearby White Salmon River, which was named early on for the many salmon whose color had turned white after spawning. It has a hospital, clinic, K-12 schools and a weekly newspaper. Most of the city is located at, or above, 550 feet above sea level, but a portion extends downwards and includes three-fourths of a mile of Columbia River frontage. The "bluff" is a signature feature of the city and offers prime views of the Columbia River Gorge and Mt. Hood for many property owners.

The phrase, "The Land Where the Sun Meets the Rain" is often used to describe the climate in and around planning area. The area is located in a transition zone between the marine-influenced climate west of the Cascade Mountain range and the dry continental climate of the inner-mountain region. The Columbia River Gorge serves as a conduit for the differing air pressures on either side of the Cascades, resulting in major wind patterns. The transition zone typically results in strong westerly winds in the summer and chilly easterlies in the winter. The average annual rainfall for the area is about 30 inches with much of this occurring in the winter/spring seasons. Very little rainfall occurs during the summer/fall fire season. The average temperature is 67 degrees in July and 52 in October.

Employment

Klickitat County has experienced unemployment rates considerably higher than the average for Washington State. Since 1971, the unemployment rate has been above 10 percent each year, with the exception of 1999. In 2004, the rate of unemployment in the county was 12.5 percent in April and 11.1 percent in May.¹ Only one other county in the state (Ferry) had a higher level of unemployment for those periods.

The leading sources of employment for residents in the planning area are the SDS Lumber Company, Underwood Fruit, White Salmon School District, and Skyline Hospital. In White Salmon, 21 percent of employed residents work for the government while 7 percent of Bingen's workforce is government employees.² Per-capita income for Bingen is \$12,300 and \$18,000 for White Salmon. The medium household income is \$25,300 in Bingen and \$35,000 in White Salmon. Self-employment accounts for 6.8 percent of the workforce in Bingen and 7.1 percent in White Salmon. A breakdown by occupation types for the two cities within the planning area is:

¹ Bureau of Labor Statistics and Washington State labor market and Economic Analysis.

² Census 2000 results for Washington.

Occupation	Bingen (%)	White Salmon (%)
Management, Professional	20	29
Service	15	14
Sales, Office	18	25
Farming, Forestry, Fishing	8	5
Construction	8	7
Production, Transportation	31	20

Housing

There were 327 homes in the City of Bingen in the year 2000; 225 or about 70 percent of these were considered one-unit dwellings and 23 were mobile homes. Of the total number of Bingen dwellings in 2000, 268 or 82 percent were constructed before 1980.³ Since 1995, there have been 29 new homes developed in the city, or an average of about three per year. Of the 29 new residences, 17 were manufactured homes and 12 were stick-built.

In White Salmon there were 949 homes existing in the year 2000, of which 624 (66 %) were one-unit dwellings and 131 were mobile homes. A total of 728 or 77 percent of the homes existing in the year 2000 were built before 1980. Since 1991, there have been 177 new homes constructed, or an average of about 13 per year.

Many of the new homes recently constructed in the planning area were built west of the City of White Salmon boundaries in what could be considered more of a rural environment. Since 1990 there were 190 new dwellings built in this area. Much of this new construction occurred in the Strawberry Mountain and Pucker-huddle area. The rate of new home construction in the urban areas of both cities, and notably in Bingen, has been relatively slow

The fact that so many of the homes existing in the cities of Bingen and White Salmon were constructed before 1980 is significant. While these homes tend to be on smaller lots than in the more rural areas, vegetation has grown up significantly over the past 25 to 30 years. When new homes are constructed, vegetation is typically smaller in size as compared with more established homes. Landscaping generally occurs with construction and after 25 or 30 years it often has grown significantly. The result is a much heavier fuel load than what existed at the time of construction.

New home construction in the more rural areas often occurs in areas with existing heavy fuel loads. With construction, some of this vegetation is removed so the result may be an initial reduction in the fuel load. Over time, fuel loads tend to increase unless a maintenance program to reduce fuels is carried out.

³ Census 2000 results for Washington.

Fire Occurrence History

The White Salmon/Bingen area has been fortunate in that it has not recently experienced a large wildland fire with the loss of structure or human life. However, there have been close calls. Several fires have occurred on the "bluff" and most have burned to the top of the ridge before being controlled. The most recent event was in July of 2003 when a fire started next to Highway 14 and burned nearly to the top of the bluff before it was suppressed by aggressive actions from the fire departments, DNR, and two contract helicopters with water buckets. There was very little wind that day or this fire would likely have had a much more serious result.

The White Salmon Fire Department averages about 50 responses for a variety of situations each year.⁴ Fire calls involve structure fires including chimney fires, grass and brush fires, vehicle related including fires and accidents, and several types of miscellaneous calls such as natural gas leaks, downed power lines, and false alarms. A breakdown of fire calls by type for the years 2000 to 2003 follows:

Year	Responses	Structure	Grass/Brush	Vehicular	Miscellaneous
2003	60	30	10	10	10
2002	66	10	6	11	39
2001	53	11	12	11	19
2000	46	6	10	10	20

Fire Protection

Both Bingen and White Salmon have volunteer Fire Departments, although the Fire Chief for White Salmon is partially funded. The White Salmon Fire Department has 34 members while Bingen has 11 as of July, 2004.

The White Salmon Fire Department is under contract with Rural Fire District #3 (Husum area) to provide protection for the Puckerhuddle area just west of the city limits of White Salmon.

The Bingen/White Salmon area has a Fire Protection Classification rating of six for fire insurance purposes. The classification system is from one to ten with a one being the best rating and having the lowest premium rates.

IV. Wildfire Hazard Assessment.

Wildfire behavior is affected by weather, topography, and available fuels. These components affect the likelihood of a fire starting, the speed and direction it will travel, the intensity it burns, and the ability of firefighters to suppress it. While weather and

⁴ White Salmon Fire Department Fire Reports, 2000 to 2003. Records for previous years are missing.

topography cannot be controlled, fuel situations can be managed. Therefore, the assessment and management of fuels presents the best opportunity to prepare for, or prevent, a wildfire event.

A wildfire hazard is a fuel complex that influences the ease of ignition and resistance to control of a wildfire. Wildfire hazards on an area-wide basis were mapped and rated as low, moderate, or high within the planning area. Criteria for the ratings were mainly fuel type, arrangement, volume, condition and location. Slope, aspect and wind are other factors affecting wildfire ignition and resistance to control and are discussed in this section as well. Ratings were mapped on a large scale basis and within each rated area there are likely to be some enclaves that do not necessarily conform to the overall rating for the area. For example, an area rated as moderate may likely have some portion of it that would be considered as low or high. It would not have been practical or useful to map all of these smaller areas as individual units.

Individual parcels with homes on them were also surveyed using National Fire Protection Association (NFPA) 299 criteria. Criteria for assigning ratings included access, defensible space, and construction materials. A complete list of the criteria is in Appendix A. The risk rating for individual parcels is an indication of the survivability of the home during a wildfire event threatening it. Surveyed parcels which scored high were identified on the Community Base Map. Low and moderate parcels were not displayed on the map. Importantly, ratings of individual parcels do not necessarily conform to the hazard rating for the area within which it is located. As an example, an individual home may have a high risk rating but be located within a moderate wildfire hazard area.

Fuel Conditions

Several fuel situations can be described in the planning area:

- **Forest fuels, heavy loads.** About 820 acres or 34 percent of the planning area is forested with large conifer and hardwood trees. Conifers consist mainly of Douglas fir and ponderosa pine while the hardwoods are mostly Oregon white oak. Conifer trees tend to be more combustible and produce more heat than the hardwoods. Underbrush is often thick providing a ladder fuel effect⁵ helping fire to reach into the crowns of the larger trees. Much of this forested area occurs in relatively large blocks of land with few effective fuel breaks. These blocks surround most of the City of White Salmon and much of Bingen. The most serious threat to the cities is the steep slope above Highways 14 and the 141 cutoff roads. These areas not only contain heavy forest fuel loads, but have extremely steep slopes as well. All of the areas with heavy forest fuels have been mapped as a “high” wildfire hazard rating. They represent some of the most serious wildfire hazards in the planning area.

⁵ Ladder fuels are those which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.



Hazardous fuel and steep slope situation on the bluff above Highway 14. This is an example of a high hazard fuel rating area.

- **Light forest/brush/grass fuels.** Approximately 605 acres, or 25 percent of the planning, is classified as light forest fuels. These areas typically have scattered trees, usually ponderosa pine or Douglas fir. Areas with scattered trees also have heavy concentrations of brush and grass. Some areas are in brush and, or, grass without trees. This fuel type is often referred to as flashy fuels⁶. They do not typically produce as much heat or firebrands⁷ as the heavy forest fuels described above, but they support faster moving wildfires. These fuel situations mainly occur on slopes of less than 30 percent. These areas have been mainly mapped with a “moderate” wildfire hazard rating. Within some large areas rated as moderate or medium fuel hazards are smaller areas which would meet the criteria for high or low rated areas.

⁶ Flashy fuels are those such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, which ignite readily and are consumed rapidly when dry.

⁷ Firebrands are any source of heat, natural or human made, capable of igniting wildland fuels. They are flaming or glowing fuel particles that can be carried naturally by wind, convection currents, or by gravity into unburned fuels.



Scattered brush, tall grass and trees. Moderate hazardous fuel rating.

- **Orchards.** Most of the orchards have been removed in recent years but about 50 acres remain making up about two percent of the planning area. Fuel situations in most of the remaining orchards are light and are not much of a hazard from a wildfire standpoint. In most cases, grasses and weeds are controlled and the area is irrigated for much of the fire season. The fruit trees and underbrush can burn and are most vulnerable to wildfires during the fall season after harvest, when irrigation stops. The orchard areas have been mapped with a “moderate” wildfire hazard rating.
- **Residential/commercial.** This fuel type makes up about 86 acres in Bingen and 220 acres in White Salmon, or a total of 306 acres and 13 percent of the planning area. It consists of the downtown portions of both cities and their respective residential areas that have been heavily developed. It does not include some of the outlying areas with more sparse development.

Fuels in these areas range from light to moderate overall but some individual parcels have high hazard fuel situations. Fuels include conifer and hardwood trees and smaller, landscape-type vegetation. In some cases, trees and bush-type vegetation combine in close proximity to homes creating a dangerous fuel situation from a wildfire suppression standpoint. Landscape vegetation around many homes built 15 years or more has grown up and now constitutes a serious wildfire hazard. The residential/commercial areas are mapped as either a “moderate” or a “low” wildfire hazard rating.

- **Rural Residential.** About 325 acres, 14 percent of the planning area, is classed as rural residential. It includes residential areas outside of the heavily developed portions of the two cities. Typical examples of this type of fuel situation include the Los Altos subdivision and Puckerhuddle. Fuel situations are similar to that found in the residential/commercial areas but are often considered more hazardous on some individual parcels. Because lot sizes are typically larger, there tends to be a higher concentration of trees, especially large conifers. Also, in many cases, homes are located adjacent to large blocks of heavy forest fuels and many are constructed with highly combustible materials such as cedar siding and wooden shake roofs.

Most of the area considered as rural residential has been mapped as a “moderate” wildfire rating. However, some of these areas contain heavy forest fuels and should be considered as having a “high” wildfire hazard rating.



Rural residential area with hazardous tree and grass fuels.

- **Industrial.** Approximately 285 acres or 12 percent of the planning area is termed industrial lands. This area is mainly the SDS Lumber Mill, Underwood Fruit, and the Port of Klickitat property on Bingen Point. The fuel situation ranges from heavy at the lumber mill to light on the Port and Underwood Fruit property. Fuels on the SDS Mill property include log decks, sawdust piles and buildings. While there are heavy fuel hazards on the mill site, it is not considered a serious risk from a wildfire standpoint to the rest of the planning area since it is somewhat isolated by the railroad and Highway 14.

Fuels on the Port’s property are generally light consisting of grass, weeds and brush. Although these fuels can be flashy during much of the fire season, the fuel situation from a wildfire hazard standpoint is not considered to be a serious problem. The Port property is isolated from the rest of the planning area by the railroad and Highway 14 and bordered by the Columbia River to the south.

The areas considered as industrial lands have been rated as a “moderate” wildfire hazard rating.

- **Farmland.** About 10 acres or less than one-half percent of the planning area is in irrigated farm land. This area within the city limits of Bingen is considered to have a light fuel situation consisting mainly of irrigated vegetable crops. This area is rated with a “low” wildfire hazard rating.

Table 1 summarizes the number of acres by fuel type in the planning area.

Table 1 Number of Acres by Fuel Type

Fuel Type	Number Acres	Percent of Planning Area
Heavy Forest	820	34
Light Wildland	605	25
Orchard	50	2
Residential/Commercial	306	13
Rural Residential	325	14
Industrial	285	12
Farmland	10	-
Total	2,401	100

In addition to type and arrangement, the moisture content of fuels helps determine how a wildfire will behave. As fuels dry out in the summer and fall, ease of ignition, rate of spread and flame length all increase. Weather conditions within the planning area are normally hot and dry for most of the summer and fall and the moisture content of fuels typically lowers significantly.

Slope

The rate of wildfire spread becomes faster as the percent of slope increases.⁸ It is estimated that the rate of spread is twice as fast on a 30 percent slope as compared with a level surface. Combustion is accelerated on steep slopes because of increased heat transfer through radiation and convection.⁹ Fuels on the upslope side of a fire are warmed faster through radiant energy since they are closer to the source of heat. Additionally, these fuels are heated by convection currents which tend to rise upslope because of their lighter weight

Much of the area within the planning area is located on steep slopes where a wildfire would burn rapidly. Table 2 shows the number of acres within the planning area by four slope classes. Thirty-five percent of the planning area, or 835 acres, is on slopes greater

⁸ Davis, Kenneth Pickett. 1959. Forest fire control and use. McGraw-Hill Book Co. New York, 584 pps.

⁹ Barrows, J.S. 1951. Fire behavior in northern Rocky Mountain forests. Northern Rocky Mountain Forest and Range Experiment Station. Station Paper No. 29. USDA Forest Service. Missoula, Montana. 103 pp.

than 30 percent. Most of this area is on the steep slopes between Highway 14 or the 141 cutoff road and the top of the bluff. These slopes are much greater than 30 percent and wildfires would burn very rapidly there as compared with a fire on a more level surface. The Strawberry Mountain area also has very steep slopes. Importantly, nearly all of the area with steep slopes also has heavy forest fuels. This combination makes for an unusually severe wildfire hazard.



Steep slope situation on the south facing aspect (bluff area).

Table 2 Acres by Percent Slope

Percent Slope	Acres	Percent of Planning Area
0-10	260	11
10-20	780	32
20-30	525	22
30+	835	35
Total	2,400	100

Other factors including aspect and wind also influence the behavior of wildfire.

Wind

While wind does not fit within the definition of a wildfire hazard, it is an element which must be factored in the consideration of wildfire behavior in the planning area. Increased wind velocity, like increased percent slope, accelerates wildfire rate of spread. Like slope, the rate of fire spread increases as the wind speed increases. This effect is attributed to three factors. First, wind induces a forward lean of the flame front, which reduces the distance between the flame and un-ignited fuel. Second, increased wind speed increases the rate of convective heat transfer between the heated air and the un-ignited fuel particles. Third, wind passing through the interior of the fuel bed speeds the loss of moisture in the fuel particles, reducing the energy required for ignition. All of these effects are greatest in the prevailing direction that the wind is blowing.¹⁰

The planning area is strongly affected by wind during much of the wildfire season. During the summer strong westerly winds from 15 to 30 mph are typical. These winds are produced by pressure gradients between cooler coastal marine air and the hot, dry desert air east of the planning area. Winds tend to be strongest in the afternoon hours when temperatures are highest and vegetation has its lowest moisture content adding to the potential for large and fast moving wildfires. In the fall and winter, easterly winds are more common and can affect fire behavior as well. However, temperatures are cooler and fuel moisture content is higher so the threat from wildfires is less.

Aspect

In general, south-facing slopes receive more direct sunlight throughout the day in comparison to north-facing slopes. The ambient fuel temperature on a southwest-facing slope will be significantly higher in the late afternoon because of the increased radiant solar energy received by fuels at these aspects. As a result, fuel particles on southwest-facing slopes are at an elevated temperature and require less energy to be raised to their ignition temperature.

Almost all of the planning area is on a south facing aspect and affected by the increased heating effect of direct sunlight. This is a significant for wildfire behavior in the planning area since the Bingen-White Salmon area receives a high proportion of sunny, hot days during the wildfire season.

Summary

The planning area contains significant wildfire hazards in the form of large blocks of heavy forest fuels, lighter brush and grass areas (flash fuels), and landscape-type vegetation around homes. In many cases these hazards are in close proximity to occupied homes presenting a serious threat in the event of a wildfire. Wildfire hazards areas are mapped and rated as low, moderate, and high on the community planning map: few areas with a low rating exist. Steep slopes, southerly aspects, strong winds, and hot, dry conditions during the fire season add to the wildfire hazard situation in the planning area.

¹⁰ Morais, Marco. Fire Behavior Variables, 2001.
www.physics.ucsb.edu/~complex/research/hfire/fbehave/fbehave/_variable.html.

. V. Wildfire Risk

Risk is the chance of a wildfire starting. It is determined by the presence and activity of causative agents. For the planning area, the causative agents are primarily: the railroad, Highway 14 and Alternate 141, fireworks, lightning, power lines, debris burning, discarded cigarettes, house fires.

Railroad

The Burlington Northern-Santa Fe Railroad runs the length of the southern boundary of the planning area. This busy railroad has the potential of starting a wildfire which could affect homes and residents in the planning area. While there is a firebreak formed by Highway 14, there are ample fuels in the strip between the railroad and highway to support a significant wildfire. Once a fire starts within this narrow strip of vegetation, there is potential for it to spot across the highway and get started on the steep slope containing heavy forest fuels below the White Salmon-Bingen bluff. Railroad maintenance activities, especially track grinding, has a high potential for starting fires. The railroad has taken steps to decrease the number of fires from maintenance activities including the use of fire retardants and a track mounted water tanker which they keep in the vicinity of maintenance activities. But during periods of high wind, hot temperatures, and dry conditions, there is still a strong potential for a railroad ignited wildfire. Railroad officials have expressed an interest in working with the cities in a wildfire prevention effort



Burlington Northern/Santa Fe Railroad at the base of the White Salmon bluff.

Highway 14, Highway 141, Alternate 141 and Dock Grade

These busy roadways are considered high risk factors for wildfire starts. Risk factors include vehicle accidents and discarded cigarettes. Highway 14 from the White Salmon River to the Dock Grade is relatively narrow increasing the chance of vehicle accidents. An accident involving a burning vehicle could easily start a fire in the steep, heavily forested slope leading to the bluff above. There is only a short distance between the

driving surface and vegetation above the ditch line. One positive factor is there are few places for vehicles to pull over and stop. This factor reduces the chance of drivers starting a fire while taking a break along the roadway.



Steep grade and narrow width road (Dock Grade)

Fireworks

The use of fireworks can quickly lead to the ignition of a wildfire within the planning area. Klickitat County has wisely banned fireworks, except for a short period during the July 4th celebration. However, illegal use of fireworks still occurs occasionally and is considered a serious wildfire risk factor. Because they are illegal for most of the year, a person choosing to use them will likely select a more remote location which may have a high wildfire hazard situation.

Power lines

Power lines are located within the planning area and branches or trees falling on them could ignite a wildfire. Also, there is the potential for a wildfire start from a vehicle accident striking a power line.

The Klickitat PUD does not have a formal plan for wildfire situations. They do monitor fire frequencies and if they hear of a fire in a location where they have distribution or transmission line, their operations section will dispatch a crew. Often, when the fire department requests them, the PUD is already on the way.



Powerline situated within hazardous fuel situation.

Lightning

Lightning could potentially ignite a wildfire in the planning area, although this has not been a major factor in recent years. There is no way to predict where a lightning strike might occur. Fortunately, most of the lightning that does occur in the planning area is connected with rain events, as contrasted with “dry” lightning which is a much bigger problem. Also, because the planning area is fairly heavily populated thought-out, a lightning strike would most likely be noticed and reported quickly.

Debris Burning

Open burning is banned year-round in the City of White Salmon. For Bingen and the portion of the planning area outside of the city limits, open fires are allowed during a burning season, but permits are required. The period when open fires are allowed by permit is approximately from the first of November to the end of May. Some illegal burning does occur and is an important risk factor for wildfire starts.

The county operates a chipping facility on Bingen Point where residents can dispose of small diameter woody material. This service has helped reduce the incidence of open burning and the potential for a wildfire start from this practice.

Discarded Cigarettes

A lighted cigarette, tossed from a moving vehicle, has long been and continues to be a major source of wildfire ignition. There are many miles of roads within the planning

areas so this risk factor could come into play almost anywhere. However, the potential is greatest in the more rural portions of the planning area where there is no curb and gutter or sidewalks to act as a fire barrier.

House Fires

House fires could easily be an ignition source for a wildfire in the planning area. Fires which get a good start in a house can easily sent firebrands onto nearby vegetation. Many residents rely on wood burning stoves for heat and a chimney fire is another source of firebrands. This risk factor is more of a problem in the rural portions of the planning area because of the higher fuel loads present.

Other Risk Factors

There are other risk factors to consider in addition to the major ones discussed above. Forest fires beginning outside of the planning area could spread into the area. Fire caused by an arsonist is a risk factor although this has not been a problem in the past. Children playing with matches have ignited wildfires in the past and this could happen again. Although unlikely, an airplane crash could occur resulting in a wildfire situation.

Summary

There are serious risk factors presenting the potential for wildfire ignition within the planning area: railroad, vehicle accidents, house fires, fireworks, lightning, power lines, debris burning and discarded cigarettes.

VI. Emergency Preparedness

Klickitat County Emergency Management Plan

The Klickitat County Emergency Management Plan gives guidance for the coordination of local fire department operations during local incidents. The Plan outlines responsibilities of the local agencies and the Klickitat County Emergency Management Department. It provides an organizational framework to effectively use available firefighting equipment and manpower, control dispatching of equipment and/or manpower and provide effective operations at the incident location. Important elements of the Emergency Management Plan related to wildfire situations include:

- The local fire departments “will utilize all reasonable mutual aid **only within** the county, or Washington State counties.”
- For fires which threaten, or have the potential to overwhelm the local department, “**assistance shall be requested through the local County Department of Emergency Management (DEM).**”
- The plan (Annex G) address the evacuation of people during an emergency.
- The **Incidence Command System (ICS)** will be utilized by all response organizations under the direction of the Chief Fire Official or designee.

- The local fire department will coordinate the release of public information through the DEM Public Information Officer.
- The DEM will provide for the alert and warning of persons located within the fire area.
- The DEM will assist local fire departments as needed with equipment, manpower, communications, food and shelter.
- The state DEM will coordinate the procurement of resources as requested by the Incident Commander (through the Klickitat DEM).
- The Plan (Annex Q, Attachment one) provides a dispatch protocol and states that the Klickitat DEM will be notified when: mutual aid is requested, evacuation of people is needed, a fire is out of control, hazardous material or explosives are involved, non-member volunteers are used.

Creating a Defensible Space

In the event of a major wildfire, there may not be enough firefighting resources available to defend every threatened home. In this case, firefighters would make decisions about which homes they can safely and effectively protect. Homes with dense vegetation, highly combustible building materials, and, or, limited access may be lower priority for protection. Homes with an effective defensible space and non-combustible roofs are many times more likely to survive a wildfire. Under extreme conditions, almost any house can burn. But having a defensible space will significantly improve the odds of a home surviving a wildfire. The most important person in protecting a house from wildfire is the homeowner and actions taken by them before a wildfire occurs (such as creating a defensible space) is critical.

Defensible space is the area between a home and an oncoming wildfire where vegetation has been modified to reduce the wildfire threat and to provide an opportunity for firefighters to effectively defend the house.¹¹ Nearby vegetation can greatly influence the survivability of a home in a wildfire situation. All vegetation is potential fuel for a wildfire. Properly modified and maintained vegetation can slow the spread of a wildfire, keep flame lengths low, and reduce the level of heat, all of which allow firefighters a better opportunity to protect a nearby structure.

The optimum size of each home-owner's defensible space depends on the type of vegetation growing near the house and the steepness of the terrain. It varies from about 30 feet to as much as 200 feet. On flat to gently sloping ground surrounded by mainly grass vegetation, the recommended defensible space is 30 feet. In situations with very steep slopes (more than 40 percent) and surrounded by heavy forest vegetation, a 200 foot defensible space may be needed. Homeowners should seek assistance from their local fire department or the Washington Department of Natural Resources to (WDNR) to help determine a proper defensible space for their particular situation. The "Living with Fire" guide available from the WDNR has a section called "Creating an Effective

¹¹ Living With Fire, A Guide for Homeowners. Pacific Northwest Wildfire Coordinating Group

Defensible Space” which describes how landowners can create a defensible space on their property.

To create an effective wildfire barrier within their defensible space, a home-owner should modify and maintain vegetation in the following manner:

- Remove all dead vegetative material including: standing and down trees, shrubs, grasses, wildflowers, weeds, needles, leaves, branches, cones, firewood.
- Remove all, or most, live trees and shrubs within 30 feet of the home. Note: advice from the local fire department and, or, the WDNR is strongly recommended. Some trees may be retained or the 30 foot distance may have to be increased, depending on slope and vegetative conditions.
- Wildfire threat is directly related to the density and continuity of vegetation. Homeowners can decrease their wildfire risk by providing cleared space between plants.
- Use fire resistive, high moisture content varieties of vegetation for landscaping. All plants will burn under extreme fire weather conditions such as drought. However, plants burn at different intensities and rates of consumption. “Fire-resistive” plants burn at a relatively low intensity with slow rates of spread and short flame lengths. Plants that ignite readily and burn intensely are “fire-prone” plants. Favor low growing herbaceous plants (non-woody) including grass, clover, groundcover, bedding plants, perennial flowers, and conservation grasses. Emphasize the use of rock, concrete sidewalks, brick patios, and asphalt driveways. Favor short deciduous shrubs and trees over coniferous trees. Avoid juniper, arborvitae, mugo pine and tall exotic grasses. See Appendix for a detailed list of fire resistant and fire prone plants and their characteristics.
- Remove or thin overcrowded or weakened trees beyond the 30 foot distance from the home and up to 200 feet away depending on slope and vegetative conditions. Work with adjacent neighbors if necessary to get proper spacing from affected homes. Prune low-hanging branches (6-10 feet above ground) to keep a ground fire from climbing into upper branches.
- Stack wood, construction debris, and other flammable materials at least 30 feet away from your home. Keep flammable vegetation 10 feet away from woodpiles.
- Clean pine needles, leaves and debris from roof, gutters, decks and yard. Clean up after storms. This is especially important during the dry summer months when a single spark can ignite a fire.
- Dispose of cuttings and debris material promptly. Consider alternative disposal methods like composting or recycling to get rid of yard and garden debris.
- Do not keep combustible material under decks or elevated porches.

- Make trellises of non-combustible material.
- Keep lawn area mowed, watered and green. Maintain irrigation system in good working order. Consider establishing an alternative water source, pump and power source for fire suppression purposes.
- Remove tree branches within 15 feet of a chimney.
- Design driveways and walkways to serve as fuel breaks.
- Annually maintain vegetative modifications to keep defensible space effective.
- When conducting open burning with barrels (where allowed and with proper burning permits) clear flammable material at least 10 feet around the barrel and cover the top with a screen (1/4 inch or smaller mesh).



Excellent example of home with defensible space.

Structural

While no man-made structure should be considered “fire proof”, fire resistive home construction materials can greatly decrease the chance of a wildfire starting a house on fire. The following should be considered during new home construction, or during remodeling or maintenance activities:

- The roof is the most vulnerable part of a house in a wildfire situation. Wooden shake roofs should be replaced with a class C or better fire resistant roof as soon as possible. Treating wooden shake roofs offers some level of protection, but the benefit is typically short-lived.
- With new home construction, use fire resistive or non-combustible material for sidings, roofs, and decks. Siding materials which resist heat and flames include cement, plaster, stucco, and concrete masonry such as stone, brick, or block.
- Exposure to heat can cause windows to fracture and collapse providing an opening for flames or firebrands to enter and ignite the interior of a structure. Glass products that can withstand convective and radiant heat will reduce this risk. Tempered glass can withstand much higher temperatures than plate glass and is recommended for large windows, especially if they overlook steep or heavy vegetation. Double pane glass is slightly more resistant to heat than single pane glass.
- Homes must have smoke detectors and should have fire extinguishers. Sprinkler systems in the home provide an extra level of protection.
- Keep garden tools like rakes, hoses and shovels easily accessible. Make sure everyone in your home knows where this equipment is, and how to call for help in the event of an emergency.
- Maintain at least two ground-level doors as safety exits. Each room should have two means of escape via a door or window combination.
- Prevent sparks from entering the house by covering vents with wire mesh (maximum of 1/8" openings).
- Enclose overhanging eaves and decks.
- Maintain spark arresters on chimneys.
- Locate butane and propane tanks at least 30 feet from any structure and provide 10 feet of clearance around them.
- Locate new homes at least 30 feet from all property lines to assure the opportunity to develop and maintain an effective defensible space. Build away from ridge tops, canyons, and areas between high points on a ridge.
- For homes with their own wells, maintain an emergency generator to operate the pump during a power failure.
- Make sure electric service lines, fuse boxes and circuit breakers are installed and maintained according to code. Have qualified service people perform electrical maintenance and repairs.
- Bridges should be constructed to support the weight of emergency vehicles.



Metal roof, stucco siding. Good example of fire resistant features.

Access

- Maintain at least two means of ingress and egress (each with two-way traffic) for emergency purposes.
- Identify at least two emergency exit routes from the neighborhood.
- Identify dead-end roads and weight and height restrictions with clear signs. Provide wide areas at the end of dead-end roads to allow emergency vehicles to turn around. Construct turnouts along one-way roads.
- Assure driveway access is wide enough for emergency vehicles and with ample room for turnarounds.
- Clear flammable material at least 10 feet from roads and five feet from driveways. Remove overhanging branches above roads.
- Mark houses and driveways with house numbers clearly visible from the road. Assure streets are named and marked with clear signs at each intersection.



Narrow access road serving many homes with one means of ingress/egress.

Safety Zones

Safety zones are pre-arranged areas where persons threatened by wildfire can meet and safely wait until the fire emergency passes. Such areas must have more than one high standard access road and ideally have adequate parking for vehicles, an indoor meeting place, bathrooms, and access to telephones and, or, computers with internet access.

Several options appear to be available for safety zones in the planning area during a wildfire emergency. For the White Salmon area, the high school area may be the optimal facility.

Evacuation Routes

During a wildfire emergency, an incidence command organization would be assembled to manage the fire. The Incident Commander would make the decision to evacuate residents if it were necessary from a safety standpoint. The Incident Commander and his/her staff would consult with the Klickitat DEM and local police departments to determine evacuation routes, should they be needed. The police departments would carry out the evacuation process. It would not be possible to predetermine evacuation routes because every wildfire situation will be different and require decisions based on the particular situation. Evacuation routes would depend on the origin of the fire, the direction the fire is advancing, fire behavior, wind conditions, time of day, etc. Some points to consider regardless of the fire situation:

- During a bluff fire, Highway 14 would likely be closed to accommodate fire fighting equipment. This would also apply for a fire along Alternate 141, and Highway 141.
- Some roads within the planning area would not be good evacuation routes. Lincoln Street is narrow with sharp curves and would present a dangerous situation during an emergency.
- In most wildfire situations requiring an evacuation, it would be safest to evacuate residents down to Highway 14 since most large wildfires would be advancing in a northerly direction.
- The High School property would be a good option for White Salmon residents to gather during a wildfire situation. The Port property would be a good option for Bingen residents.

Fire Assistance Agreements

The White Salmon Fire Department has a contract with the Husum Fire Department (Rural District # 3) to provide protection for the area outside of the City of the White Salmon, but in the planning area. This covers the area west of White Salmon to the White Salmon River and south of the city's urban growth boundary. Included is the Puckerhuddle area and Los Altos Subdivision.

The WDNR and the USDA Forest Service respond to fire calls made to the White Salmon and Bingen Fire Departments. The WDNR will respond to any incidence which occurs on, or threatens, areas covers by the Forest Patrol Assessment. For all practical purposes, this would cover all of the planning area. The Forest Service will also respond to these areas. Therefore, when a wildfire occurs within the planning area, the White Salmon, Bingen, WDNR and USFS may all respond, depending on the situation.

The White Salmon and Bingen Fire Departments have mutual aid agreements. Either department will respond to a fire in the neighboring city when the primary department cannot. In some situations, one department will backup the other. When necessary, both departments will respond to the same call.

White Salmon and Bingen also have agreements with Oregon counties including Hood River, Wasco, and Morrow.

Response Capability

Both the White Salmon and Bingen Fire Departments have equipment needs they feel would make them more effective. The Bingen Department is in the process of acquiring a new brush/tanker truck. A list of equipment needs for the White Salmon Department is in the Appendix.

Developing a Personal Emergency Plan for Wildfire Protection¹²

The following checklist may be used to help develop a personal Emergency Wildfire Plan. Residents should ask their local fire department officials for advice and discuss with neighbors about tools, equipment and other resources they could share in an emergency.

Elements of Plan

- **Evacuation Plan.** Early evacuation is the safest way to avoid injury or death. Timing and other factors can vary so widely that each household needs its own specific plan, including options to cover anything that might happen.
- **Escape Routes.** Normal and alternate escape routes.
- **Safety Zones.** Locations of and routes to large areas with little or no vegetation or other fuels where family members can ride out the fire if it is too late to evacuate.
- **Communication.** Pre-arrange normal and alternate ways to stay in touch with family members, even if phones are out. Family members might "check in" with a friend or relative in another area as soon as they are able.
- **Assignments.** Who is to do what when in an emergency

Provide Equipment

- **Hoses.** Pre-connected to faucets.
- **Ladder.** Long enough to reach the roof easily.
- **Fire Extinguishers.** One or more 5-pound multipurpose type, readily available.
- **Protective Clothing.** For anyone who is unable to evacuate before the fire arrives. This includes a cotton long-sleeved shirt or jacket and trousers, a handkerchief to provide minimum protection for the lungs (avoid inhaling smoke or hot gases!), leather boots, gloves, a helmet or other head covering and goggles. Cotton clothing is a "must." Synthetic fabrics can melt onto your skin.

¹² FEMA Region VIII, Living in Wildfire Hazard Areas, 2003
(<http://www.fema.gov/regions/viii/livingwithfire.shtm>)

When Caught in Wildfire

If you see a wildfire, call 911. Don't assume that someone else has already called. Describe the location of the fire, speak slowly and clearly, and answer any questions asked by the dispatcher.

Before the Fire Approaches Your House

- **Evacuate.** Evacuate your pets and all family members who are not essential to preparing the home. Anyone with medical or physical limitations and the young and the elderly should be evacuated immediately.
- **Wear Protective Clothing.**
- **Remove Combustibles.** Clear items that will burn from around the house, including wood piles, lawn furniture, barbecue grills, tarp coverings, etc. Move them outside of your defensible space.
- **Close/Protect Openings.** Close outside attic, eaves and basement vents, windows, doors, pet doors, etc. Remove flammable drapes and curtains. Close all shutters, blinds or heavy non-combustible window coverings to reduce radiant heat.
- **Close Inside Doors/Open Damper.** Close doors inside the house to prevent draft. Open the damper on your fireplace, but close the fireplace screen.
- **Shut Off Gas.** Shut off any natural gas, propane or fuel oil supplies at the source.
- **Water.** Connect garden hoses. Fill any pools, hot tubs, garbage cans, tubs or other large containers with water.
- **Pumps.** If you have gas-powered pumps for water, make sure they are fueled and ready.
- **Ladder.** Place a ladder against the house in clear view.
- **Car.** Back your car into the driveway and roll up the windows.
- **Garage Doors.** Disconnect any automatic garage door openers so that doors can still be opened by hand if the power goes out. Close all garage doors.
- **Valuables.** Place valuable papers, mementos and anything "you can't live without" inside the car in the garage, ready for quick departure. Any pets still with you should also be put in the car.

Preparing to Leave

- **Lights.** Turn on outside lights and leave a light on in every room to make the house more visible in heavy smoke.

- Do Not Lock Up. Leave doors and windows closed but unlocked. It may be necessary for firefighters to gain quick entry into your home to fight fire. The entire area will be isolated and patrolled by sheriff's deputies or police.

Survival in a Vehicle

- This is dangerous and should only be done in an emergency, but you can survive a firestorm if you stay in your car. It is much less dangerous than trying to run from a fire on foot.
- Roll up windows and close air vents. Drive slowly with headlights on. Watch for other vehicles and pedestrians. Avoid driving through heavy smoke.
- If you have to stop, park away from the heaviest trees and brush. Turn headlights on and ignition off. Roll up windows and close air vents.
- Get on the floor and cover up with a blanket or coat.
- Stay in the vehicle until the main fire passes.
- Stay in the car. Do not run! Engine may stall and not restart. Air currents may rock the car. Some smoke and sparks may enter the vehicle. Temperature inside will increase. Metal gas tanks and containers rarely explode.

If You Are Trapped at Home

Stay calm. As the fire front approaches, go inside the house. You can survive inside. The fire will pass before your house burns down.

After the Fire Passes

- Check the roof immediately. Put out any roof fires, sparks or embers. Check the attic for hidden burning sparks.
- If you have a fire, get your neighbors to help fight it.
- The water you put into your pool or hot tub and other containers will come in handy now. If the power is out, try connecting a hose to the outlet on your water heater.
- For several hours after the fire, maintain a "fire watch." Re-check for smoke and sparks throughout the house.

If Caught in the Open

- The best temporary shelter is in a sparse fuel area. On a steep mountainside, the back side is safer. Avoid canyons, natural "chimneys" and saddles.

- If a road is nearby, lie face down along the road cut or in the ditch on the uphill side. Cover yourself with anything that will shield you from the fire's heat.
- If hiking in the back country, seek a depression with sparse fuel. Clear fuel away from the area while the fire is approaching and then lie face down in the depression and cover yourself. Stay down until after the fire passes!

VII. Action Items

The following projects are intended to reduce the potential for a large and devastating wildfire in the planning area. The projects could be implemented individually, or in any combination thereof, depending on available resources. City leaders will appoint a community based committee to oversee and provide leadership in the implementation of projects. The committee will look for ways to keep interest and enthusiasm high for reducing wildfire hazards within the planning area. They will identify project priorities and seek funding in the form of grants to help achieve projects which cannot be accomplished by individual home owners. The committee will identify and utilize Firewise experts who can assist the local fire department in giving advice to homeowners as to the development of defensible space on their property and how to use fire resistant building material to make their homes more fire safe. Ideally, the committee should have representatives from the local fire department, Washington Department of Natural Resources, City Councils, WDOT, Forest Service, and interested citizens.

The committee may organize an annual Wildfire Awareness Week in combination with the annual spring community cleanup week. As part of this effort, the committee may sponsor Firewise programs for individual neighborhoods. Local firemen could ask homeowners to participate in the event and request a verbal commitment emphasizing their responsibility to do so. These visits could be combined with an assessment of the property and recommendations to reduce wildfire hazards and to develop an effective defensible space. The idea that the homeowner will be helping to reduce the risk of injury to firefighters who may have to defend their property should be emphasized.

Project Proposal 1: Increase width of existing road fuel breaks (Fuels compartmentalization)

Location: Portions of: Dock Grade, Lincoln Street, NW Lincoln Street, SW Waubish Street, and State Highway 141

Hazard: Vegetation has overgrown the space above the road reducing the effectiveness of the fuel break.

Strategy: Remove trees and brush within about 25-30 feet on either side of the road to increase fuel break effectiveness. The goal will be to create an opening of at least 60 feet wide. In some situations, the pruning of branches on conifer trees to around 15 feet above the ground would greatly decrease the ladder effect and make wildfire suppression easier for firefighters.

Benefit: These roads can, to a certain extent, provide a fuel break allowing firefighters an opportunity to contain a wildfire before it reaches areas of heavy fuel concentrations and home-sites. A wildfire could still spot across the road, but the

chances for this would be much less with a 60 foot opening. As an additional benefit, the removal of overhanging trees along these roads will help “day-light” them and improve safety during winter when snow occurs (help dry them out quicker).

Responsibility: city, county, state

Cost: Varies by road. The pruning of large conifer trees along with the removal of brush and hardwoods would decrease the cost somewhat.



Lincoln Street. Note how vegetation overhangs above the road surface.

Project Proposal 2: Spring Street and Washington Street Trailer Courts.

Location: Spring Street Trailer Court at the east end of Spring Street and the Washington Trailer Court at the east end of NE Washington Street.

Hazard: Densely spaced trailers with heavy vegetation on one, or more, sides. Vegetation is close to some trailers. Long distance to water hydrant. Only one means of ingress and egress. Access is difficult for fire fighting vehicles. There is combustible material around trailers.

Strategy: Create or improve defensible space on perimeter of trailer parks and for individual trailers. Remove combustible material near trailers. Investigate the feasibility of providing more than one means of exit during an emergency. Place hydrants closer to parks.

Benefit: Reduce threat of fire spreading from nearby wooded area (Jewett Creek).
Provide defensible space for fire fighters to work in and better access to water.
Provide emergency exits for residents.

Cost: Reducing fuel load levels adjacent to the trailer parks would be expensive.
Most work within the parks could be accomplished at a low cost. Providing hydrants
would be expensive.

Responsibility: Trailer Park owners. Trailer owners. City.



Spring Street Trailer Court. Note vegetation around trailers.

Project Proposal 3: Hazard fuel reduction on the bluff above Highway 14.

This is a huge project and is best addressed in segments. The following segments could be accomplished separately, or in one large project. The goal is to reduce the chance for a wildfire starting below to reach homes at the top of the bluff. The overall strategy is:

- Provide a fuel break along Highway 14 to keep fires small in size allowing firefighters a better opportunity to suppress them before they have a chance to advance up the steep slope.
- Reduce fuel loads on the steep slope so fires that do escape initial attack along the highway will burn with less intensity allowing fighters to suppress them before they reach homes on the bluff.

- Provide good defensible spaces around homes on the bluff so that wildfires that do reach the top of the steep slope can be suppressed by firefighters before the impact structures.

Bluff Project Segment A. Fuel barrier above Highway 14.

Location: From junction of Highway 14 and Dock Grade west to the mouth of the White Salmon River.

Hazard: Highway 14 is high risk factor for wildfire ignition. There is the risk of vehicle accidents, cigarettes thrown from vehicles, railroad fires, etc. A fire originating along the Highway will likely run to the top of the bluff before there is a change to suppress it. There are heavy fuel loads between the highway and the top of the bluff

Strategy: Currently, there is a pattern of rocky openings scattered along this portion of the highway, which by themselves serve as a partial fuel break. Removing all, or most, of the vegetation between these natural breaks would link up the existing rocky areas resulting in a continuous fuel barrier. A fuel break of about 100 feet or more above the highway is envisioned. Vegetation consists mainly of oak trees with a few pine and fir along with brush and grass. Pruning the branches of large conifer trees to about 15 feet above the surface would be less expensive, safer, and still accomplish the fuel break objective. Grazing goats and sheep as described in Segment B would accomplish some of the objectives for this segment.

A maintenance program would be required to keep the fuel barrier effective. Some combination of herbicide and, or pre-emergence spray would be needed for about 20 feet above the highway each year. Approval of a large number of land owners would be needed.

Benefit: It would be best to keep a fire from starting in the first place rather than fighting it on the steep slope, or waiting for it to reach the top of the bluff where many expensive homes are located. Once a fire gets a good start on the steep slope leading up to the bluff, it becomes very difficult to deal with and there is a good possibility that it will spot to areas well beyond the bluff including the Strawberry Mountain and downtown White Salmon area.

Cost: \$25,000 to \$50,000

Responsibility: WDOT, city, county

Bluff Project Segment B. Reduce fuel load across the entire bluff with grazing animals:

Location: This segment would cover the entire face of the steep slope from the highway to the top of the bluff, approximately 230 acres.

Hazard: There are heavy fuel loads across the entire face of the bluff consisting of hardwoods (oak and some maple), conifers (fir and pine), brush (lots of poison oak), and herbaceous plants. Fires starting igniting from below with the right conditions

burn hot and are very difficult to control. Also, it is dangerous to place firefighters on the bluff for suppression purposes.

Strategy: The objective is to reduce the fuel load across the entire slope to keep fires which escape initial attack along the highway small in size and burning with lower flame lengths allowing firefighters a better opportunity for suppression actions. Goats and sheep will graze the entire slope once a year for four years. After that, a maintenance program of grazing once every three or four years will keep fuel loads down. Goats eat the woody material while sheep prefer the grass and herbaceous species.

Benefit: Reducing the fuel load across the slope will keep flame lengths from wildfires that do occur low and improve the effectiveness of suppression actions. Fires that do reach the top of the bluff would be easier to contain and there is much less chance of spotting. The use of goats and sheep for grazing is cost effective and eliminates most of the safety concerns of placing workers on the slope.

Responsibility: City of White Salmon and Bingen, the county and property owners.

Cost: \$5,000 to \$10,000 per year.



White Salmon and bluff situation.

Bluff Project Segment C: Fuel barrier between the railroad and Highway 14:

Location: From junction of Highway 14 and Alternate 141 east to the interstate bridge, approximately 12.3 miles.

Hazard: Railroad maintenance and moving trains cause numerous fires each year. If a fire gets started between the rail line and Highway 14, there is the possibility it will

spot across the highway and spread up the steep slope to the bluff and the many homes there. Vegetation along this stretch is heavy in places consisting mainly of hardwoods and brush with some conifers.

Strategy: Remove trees and brush between the rail line and the highway. Maintain with annual applications of herbicides and pre-emergence sprays. Pruning the branches of the larger conifers to about 15 feet above the ground will accomplish the objective of the project and keep the cost lower.

Benefit: While there is little concern for the effects of a wildfire between the rail line and the highway, there is a high level of concern is for the fire spotting across the slope above the highway. It is best to keep a fire from starting in the first place and prevent the risk of it spreading across the highway and up the steep slope.

Responsibility: Railroad?? WDOT

Cost: \$5,000 to \$10,000 for the initial treatment.



Vegetation between railroad and Highway 14 above.

Bluff Project Segment D: Develop defensible space around homes on the bluff.

Location: Bluff parcels from the west end of Eyrie Road east including SW Cherry, Dogwood, SW Waubish, SE Oak, Lois lane.

Hazard: There are about 75 homes located on the west-facing bluff above highway 14 and the railroad. The area between the highway/railroad is a very steep slope with a heavy fuel load of trees and brush. A wildfire starting on the railroad or highway

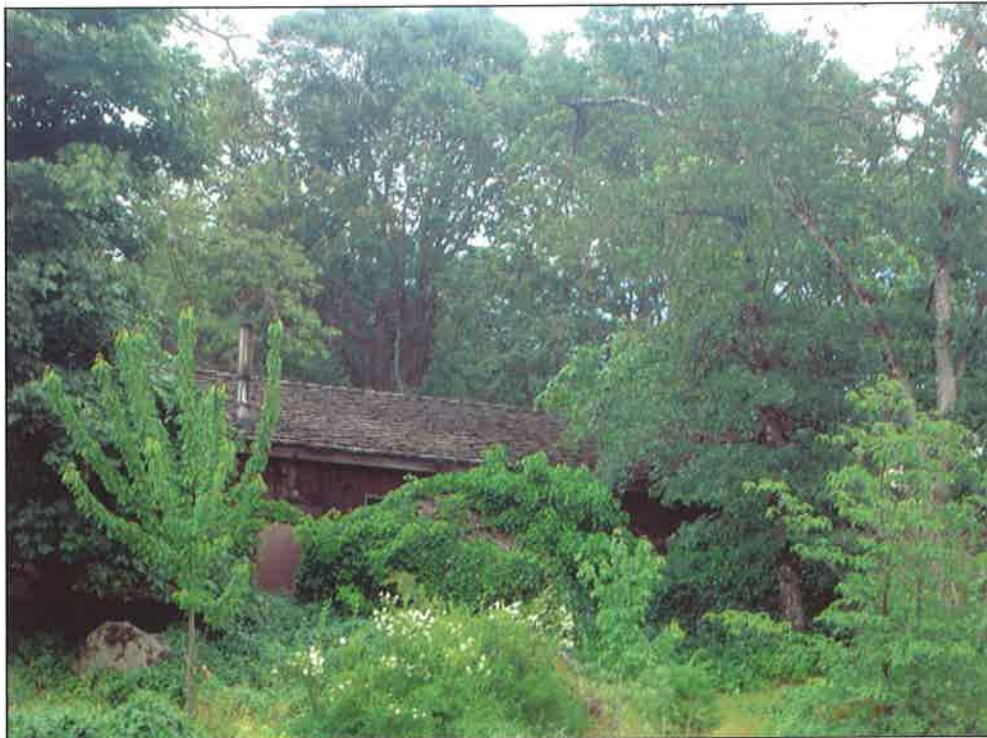
could easily spread up the slope and quickly reach the bluff area and threaten these homes. Many of the homes do not have a good defensible space around them. In some cases there is vegetation leading up to, and in close proximity of the dwellings. A good portion of the homes have combustible construction materials such as wood siding and, or shake shingles.

Strategy: A program to make home-owners aware of the hazards and what they can do to improve the situation will be conducted. A home-owners meeting will be held to present Firewise principles. This will be followed up with one-on-one field reviews with home-owners to develop custom-type plans for individual parcels. Every parcel and home situation is unique and will require site-specific recommendations. Recommendations will be given about vegetative management and the development of a good defensible space, access needs, construction materials and a maintenance program. Information will be provided by persons knowledgeable about Firewise principles.

Benefits: It is not a matter of if another wildfire will occur on the steep slope above highway 14, but when. Most fires occurring on this slope will reach the bluff and threaten homes located there. It is important that every home have a defensible space to allow fire fighters an opportunity to prevent them from being damaged, or destroyed, by fire. Efforts taken before flames and smoke approach will increase the likelihood that the Fire Department will be successful in their suppression efforts.

Responsibility: Home-owners will be responsible to complete work needed to develop an effective defensible space around their homes. The city and county will provide information and technical assistance to support the effort.

Cost: Varies by parcels.



Bluff House. Note vegetation and shake roof.

Bluff Project Segment E. Increase the fuel break width along Dock Grade

See Project Proposal 1 for description of this project.

Project Proposal 4: Strawberry Mountain Fuel Load Reduction:

Location: North of Lincoln Street to the top of Strawberry Mountain and east to the Garfield, Michigan, Achor Street area.

Hazard: Heavy forest fuel loads on the west, south and east slopes and light, flashy fuels on the north side of Strawberry Mountain. Forest fuels heavy to fir and pine with ample ladder fuels. Steep slopes and one means of ingress and egress. Numerous homes with little defensible space.

Strategy: Thin forested areas to reduce fuel loads and ladder fuel situations. Encourage (require?) mowing of vacant grass fuels. Develop defensible space around homes. Maintain reduced brush and grass fuel situations in the wooded areas with the use of goats and sheep grazing.

Benefit: Slow fire spread rate and reduce flame length to allow fire fighters a better opportunity for suppression effort.

Responsibility: Landowners with city and county support.

Cost: Varies by parcel.



North side of Strawberry Mountain. Heavy forest fuels with steep slopes are located just to the right (south) of this location.

Project Proposal 5: Improve ingress and egress opportunities in high wildfire hazard developments.

Location: Various, including SW Waubish, Eyrie, NW County Place Road, Dogwood, Strawberry mountain and numerous private drives.

Hazard: Some residential developments in the planning area are served by roads with only one means of ingress and egress. A fast moving wildfire could trap residents attempting to evacuate the area. Also, fire fighters are reluctant to enter areas without a second escape route available.

Strategy: Investigate the options available for providing more than ones means of vehicular escape during a fire emergency. Require new developments to provide more than one ingress/egress route.

Benefits: Improve safety of residents and fire fighters by having more than one escape route.

Responsibility: cities, county, homeowners.

Cost: Varies by situation.

Project proposal 6: Reduce fuel load in the Jewett Creek area.

Location: Both sides of Jewett Creek drainage from Highway 14 to the power line ROW.

Hazard: The creek drainage area contains heavy fuels in the form of hardwood and coniferous trees and brush. The drainage forms a natural “chimney” effect for a wildfire to funnel up and threaten homes on the bluff and the hospital area above.

Strategy: Remove (thin) a portion of the tree and brush cover to reduce the fuel load. Favor hardwoods over conifers for residual tree cover. Consider using goats and sheep to maintain brush level.

Benefits: Reducing the density of trees and brush would serve to decrease the rate of fire spread allowing fire fighters a better opportunity to suppress the fire. Removing conifers and brush will decrease the ladder fuel situation and help keep flame lengths low allowing for easier suppression.

Responsibility: landowners with city support.

Cost: \$10,000 to \$15,000



Jewett Creek area just east of the Spring Creek trailer Court.

Project Proposal 7: Reduce fuel load in drainage west of Puckerhuddle.

Location: The drainage located just west of the Puckerhuddle neighborhood. This drainage runs down from Highway 141 to the White Salmon River. It appears to be dry for most of the year. The project area should begin on alternate Highway 141 and continue up through the heavy vegetation.

Hazard: The creek drainage area contains heavy fuels in the form of hardwood and coniferous trees and brush. The drainage forms a natural “chimney” effect for fire to funnel up and threaten homes above.

Strategy: Remove (thin) a portion of the tree and brush cover to reduce the fuel load. Favor hardwoods over conifers for residual tree cover. Consider using goats and sheep to maintain brush level.

Benefits: Reducing the density of trees and brush would serve to decrease the rate of fire spread allowing fire fighters a better opportunity to suppress the fire. Removing conifers and brush will decrease the ladder fuel situation and help keep flame lengths low allowing for easier suppression.

Responsibility: landowners with county support.

Cost: \$15,000 to \$20,000

VIII. Monitoring and Evaluation

The Community Base Map delineates the low, medium and high hazard areas along with the high hazard parcels. These ratings establish a base, or the existing condition. As the cities and county implement the projects designed to reduce the wildfire hazard danger within the planning area, these ratings will be reduced. As projects are completed, the Community Base map should be revised to reflex the resulting changes.

Vegetative changes occur continuously but these incremental changes are somewhat difficult to notice over time. To help document changes, before and after pictures should be taken of the project areas. The pictures can be utilized to demonstrate the effectiveness of the project and the changes from year-to-year. Photo points should be established at selected locations within project areas and identified with GPS coordinates. The after pictures should be maintained in a dedicated file and periodically compared with current conditions to demonstrate changing situations.

Appendix

Appendix A. Fire-Resistive Plant Material

All plants will burn under extreme fire weather condition such as drought. However, plants burn at different intensities and rates of consumption. Fire-Resistive plants burn at a relatively low intensity, slow rates of spread and with short flame lengths. The following are characteristics of fire-resistive vegetation:

Growth with little or no accumulation of dead vegetation (either on the ground or standing upright).

No Resinous plants (willow, poplars).

Low Volume of total vegetation (for example, a grass area as opposed to a forest or shrub-covered land).

Plants with high level fuel moisture (plants that contain a large amount of water in comparison to their dry weight).

Drought tolerant plants (deeply rooted plants with thick heavy leaves).

Stands without ladder fuels (plants without small, fine branches and limbs between the ground and the canopy of overtopping shrubs and trees).

Plants requiring little maintenance (slow-growing plants which, when maintained, require little care).

Plants with woody stems and branches that require prolonged heating to ignite.

Plants that ignite readily and burn intensely are Fire-Prone plants and typically share the following characteristics:

Are water stressed

Usually accumulate fine, twiggy, dry or dead material

Have leaves and wood containing volatile waxes, fats, terpenes, or oils.

Are typically aromatic (crushed leaves have strong odors).

Have gummy, resinous sap with a strong odor.

Are usually blade-leaf or needle-leaf evergreens.

Have stiff, leathery, small or fine lacy leaves.

May have pubescent (hair covered) leaves.

May have loose or papery bark.

Are plants that flame (not smolder) when preheated and ignited with a match.

Below is a partial list of potentially available fire-resistive plants; there are many other species that would fit the criteria for fire-resistive ness that are not listed here. If the species you are thinking about using has the characteristics of a fire-resistive plant and will be properly maintained then it should work in landscaping to protect your home from wildfire.

GROUND COVERS

Succulents:

Botanical Name

Sedum spp.

Common Name

Stone crops

Non-Succulents:

Botanical Name

Achillea tomentosa

Ajuga reptans

Arctostaphylos uva-ursi

Armeria maritima

Cerastium tomentosa

Cotoneaster apiculatus

Cotoneaster dammeri

Euonymus fortunei 'Coloratus'

Potentilla tabernaemontanii (verna)

Thymus praecox arcticus

Mahonia repens

Common Name

wooly yarrow

carpet bugle

kinnikinnick

sea pink, thrift

snow in summer

cranberry cotoneaster

bearberry cotoneaster

winter creeper

spring cinquefoil

mother of thyme

creeping Oregon
grape

PERENNIALS

Botanical Name

Achillea millefolium

Common Name

western yarrow

Achillea ptarmica 'The Pearl'

Achillea tomentosa 'Nana'

Coreopsis lanceolata

Coreopsis verticillata

Geranium viscosissimum

Iris cristata

Iris missouriensis

Iris species

Lupinus sericeus

Oenothera caespitosa

Oenothera missouriensis

Penstemon deustus

Penstemon venustus

penstemon

yarrow 'The Pearl'

woolly yarrow

lance-leaved

coreopsis

coreopsis

sticky purple

geranium

crested iris

rocky mountain iris

bearded iris

silky lupine

desert evening

primrose

ozark sundrops

hot rock penstemon

blue mountain

VINES

Botanical Name

Campsis radicans

Parthenocissus quinquefolia

Vitis spp.

Wisteria spp.

Common Name

trumpet vine

Virginia creeper

Grapes

Wisteria

LOW SHRUBS, 1 ½ to 4 feet

Botanical Name

Caryopteris x clandonensis

Cornus ericea

Cotoneaster adpressus var *praecox*

Cotoneaster apiculatus

Cotoneaster horizontalis

Common Name

blue-mist spirea

red osier dogwood

creeping cotoneaster

cranberry cotoneaster

rock cotoneaster

Mahonia aquifolium 'Compacta'	compact Oregon grape
Pachistima canbyi	dwarf mountain lover
Prunus laurocerasus 'Zabeliana'	Zabel's laurel
Rhododendron 'Dora Amateis'	Dora Amateis rhododendron
Rhododendron 'Ramapo'	Ramapo rhododendron
Rhododendron 'Scarlet wonder'	scarlet wonder rhododendron
Rhododendron impeditum	impeditum/cloudland rhododendron
Rhododendron species (Azalea)	Deciduous Azalea
Symphoricarpos albus	snowberry
Yucca spp.	Yucca

MEDIUM TO TALL SHRUBS 4 to 15 FEET

<u>Botanical Name</u>	<u>Common Name</u>
Buddleia davidi	butterfly bush or summer lilac
Cotoneaster acutifolius	peking cotoneaster
Cotoneaster divaricatus	spreading cotoneaster
Cotoneaster horizontalis	rock cotoneaster
Mahonia aquifolium	Oregon grape
Philadelphus coronarius	sweet mockorange
Philadelphus lewisii	syringa
Philadelphus x virginalis	virginal mockorange
Prunus glandulosa	dwarf flowering almond
Prunus laurocerasus 'Otto Luyken'	Otto Luyken laurel
Prunus subhirtella 'Pendula'	weeping higan cherry
Prunus tomentosa	Nanking cherry
Prunus triloba	flowering almond

Prunus x cistena	purple -leaf sand cherry
Rhododendron ‘Cunningham’s White’	Cunningham rhododendron
Rhododendron ‘Daphnoides’	daphnoid rhododendron
Rhododendron ‘PJM’	‘PJM’ rhododendron
Rhododendron (species)	Rhododendron
Rhododendron: Exbury hybrids	Exbury / knaphill azaleas
Rhododendron Northern lights	northern lights azaleas
Ribes alpinum	alpine currant
Ribes aureum	golden current
Ribes sanguineum	red-flowering currant
Salix purpurea	blue arctic willow or purple osier
Salix scouleriana	Scouler willow
Viburnum trilobum	cranberry bush

SHRUB/SMALL TREES 10 to 30 FEET

<u>Botanical Name</u>	<u>Common Name</u>
Acer campestre	hedge maple
Acer circinatum	vine maple
Acer ginnala	amur maple
Acer glabrum	Rocky Mountain maple
Acer griseum	paperback maple
Acer palmatum	green Japanese maple
Acer palmatum ‘Atropurpureum’	red Japanese maple
Amelanchier alnifolia	serviceberry
Cornus alternifolia	pagoda dogwood
Cornus florida ‘Cherokee Chief’	red flowering dogwood

Cornus florida 'Cherokee Princess'	white flowering dogwood
Cornus florida 'Rubra'	pink flowering dogwood
Cornus florida 'Welchii'	tricolor flowering dogwood
Cornus kousa	kousa dogwood
Cornus mas	cornelian cherry
Fagus sylvatica 'Pendula'	weeping beech
Prunus cerasifera	purple leaf plum
Prunus cerasifera 'Newport'	Newport flowering plum
Prunus cerasifera 'Thundercloud'	Thundercloud flowering plum
Prunus sargentii	sergeant cherry
Prunus serrulata 'Kwanzan'	Kwanzan Japanese flowering cherry
Prunus serrulata 'Shirotae'	Mt. Fuji flowering cherry
Prunus virginiana	chokecherry
Prunus x blireiana	Blireiana flowering plum
Rhamnus purshiana	casara buckthorn

TREES 30 FEET AND HIGHER

Deciduous

<u>Botanical Name</u>	<u>Common Name</u>
Acer platanoides	Norway maple
Acer pseudoplatanus	sycamore maple
Acer rubrum	red maple
Acer saccharinum	silver maple
Aesculus hippocastanum	common horse chestnut
Aesculus x carnea	red horse chestnut
Alnus rubra	red alder

Catalpa speciosa	western catalpa or northern catalpa
Fagus sylvatica	European beech
Fraxinus pennsylvanica	green ash
Fraxinus pennsylvanica 'Marshall'	Marshall seedless ash
Gleditsia triacanthos var. inermis	thornless honey locust
Populus nigra 'Italica'	Lombardy poplar
Populus tremuloides	quaking aspen
Populus trichocarpa	black cottonwood
Quercus palustris	pin oak
Quercus rubra	red oak
Quercus shumardii	shumard oak
Salix alba var. tristis	golden weeping willow
Salix babylonica	weeping willow
Salix matsudana 'Tortuosa'	corkscrew willow

CONIFERS

The conifer species are not considered good trees for fire protection (due to resinous compounds in the needles). However, with some pruning and thinning you can use the native conifers in landscaping. These recommendations apply to your thin and trim zone around the house, which may extend up to 200 feet, depending on conditions around your home.

Follow these suggestions to help local conifer trees survive a fire and protect your home:

- Prune all branches 10 feet high

- Thin trees until there is a 10-foot spacing between crowns.

- Remove trees that are dead, diseased or dying.

The above list was adapted from Landscaping for Wildfire Prevention – Protecting homes on the Wildland/Urban Interface, 1998. Yvonne Carre, Chris Schnepf, and W. Michael Colt.

REFERENCE:

Backyard Forest Stewardship, 1996. Washington State Department of Natural Resources.

Landscaping for Wildfire Prevention – Protecting homes on the Wildland /Urban Interface, 1998.

Yvonne Carre, Chris Schnepf, and W. Michael Colt.

Urban-Wildland Interface Code, 1997. International Fire Code Institute.

Appendix B. White Salmon Fire Department Equipment Needs (9-2004)

Equipment Description	Estimated Cost
• Pumper vehicle	\$340,000
• Tender Vehicle	\$240,000
• High Pressure Compressor for SCBAs	\$20,000
• High Pressure SCBA Units, 20@\$5,000	\$100,000
• PVC Suction Hose, #11585-10, 2.5X10' coupled	\$376
• Duraflow hose, 11585, 1.75X50' coupled, 500'	\$1340
• Duraflow hose, #11586, 2.5X50' couples, 1000'	\$3920
• Forestry Nozzles, #10906 Twin Tip, 138@4	\$552
• Forestry hose, #11544.5, 1"X50', 500'	\$665
• Forestry Hose, #11544.1, 1"X100', 1000'	\$2320
• 1 1/2 Forestry Wye, #40065, 115@2	\$230
• Hose Quarter Turn Coup., #11660, 1"set of 2, 3300@40	\$1320
• Nomex Clothing, coat #50197, 5@110	\$550
• Nomex Clothing, pants #50189, 5@110	\$550
• Goggles #50214, 35@12	\$420
• Helmets, Wildland #50022, 10@34	\$340
• Boots-Rubber #50200, 10@96	\$960
• Infrared Heat Detector, Raynger St 60 peoplus #49980	\$349
• Heat Detector Holster #49981	\$20
• Gloves NFPA #50220 Firefighter, 20@39	\$780
• Gloves #50218 Wildland, 20@13.25	\$265
• Hoods, #50154, Long style/PBI Blend, 30@28	\$840
• Fire Shelter #50096, 10@365	\$3650

Appendix C. Glossary

Canopy: The stratum containing the crowns of the tallest vegetation present, (living or dead) usually above 20 feet.

Combustion: The rapid oxidation of fuel in which heat and usually flame are produced. Combustion can be divided into four phases: pre-ignition, flaming, smoldering, and glowing.

Conflagration: A raging, destructive fire. It is often used to connote a fire with a moving front as distinguished from a fire storm.

Control a fire: To complete control line around a fire, any spot fire there from, and any interior island to be saved; burn out any unburned area adjacent to the fire side of the control lines, and cool down all hot spots that are immediate threats to the control line, until the lines can reasonably be expected to hold under foreseeable conditions.

Cooperating agency: An agency supplying assistance including but not limited to direct tactical or support functions or resources to the incident control effort (e.g. Red Cross, law enforcement agency, telephone company, etc.).

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

Dead fuels: Fuels with no living tissue in which moisture content is governed almost entirely by absorption or evaporation of atmospheric moisture (relative humidity and precipitation).

Debris fire: In fire suppression terminology, a fire spreading from any fire originally ignited to clear land or burn rubbish, garbage, crop stubble, or meadows (excluding incendiary fires).

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

Fire cause: For statistical purposes fires are grouped into broad cause classes. The nine general causes used in the U.S. are lightning, campfire, smoking, debris burning, incendiary, machine use (equipment), railroad, children, and miscellaneous.

Fire damage: Detrimental fire effects expressed in monetary or other units, including the unfavorable effects of fire-induced changes in the resource base on the attainment of organizational goals.

Fire danger: Sum of constant danger and variable danger factors affecting the inception, spread, and resistance to control, and subsequent fire damage; often expressed as an index.

Fire hazard: A fuel complex, defined by volume, type condition, arrangement, and location that determines the degree of ease of ignition and of resistance to control.

Fire management plan: Statement, for a specific area, of fire policy, objective, and prescribed action; may include maps, charts, tables, and statistical data.

Fire prevention: Activities, including education, engineering, enforcement and administration, that are directed at reducing the number of wildfires, the costs of suppression, and fire-caused damages to resources and property.

Fire risk: The chance of fire starting, as determined by the presence and activity of causative agents

Firebreak: A natural or constructed barrier used to stop or check fires that may occur, or to provide a control line from which to work.

Fuel treatment: Manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning).

Fuel type: An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of spread or resistance to control under specified weather conditions.

Ground fire: Fire that consumes the organic material beneath the surface litter ground, such as a peat fire.

Hazard: A fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition and resistance to control.

Initial attack: The actions taken by the first resources to arrive at a wildfire to protect and property, and prevent further extension of the fire.

Ladder fuels: Fuels which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.

Mutual aid: A system wherein two or more fire departments, by prior agreement, operate essentially as a single agency to respond routinely across jurisdictional boundaries to render mutual assistance in combating fire emergencies.

Prevention: Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact, and reduction of fuel hazards (fuels management).

Rate of spread: The relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

Retardant: A substance or chemical agent which reduces the flammability of combustibles.

Suppression: All the work of extinguishing or confining a fire beginning with its discovery.

Surface fire: Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation.

Surface fuel: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants.

Wildfire: A fire occurring on wildland that is not meeting management objectives and thus requires a suppression response.

Wildland/Urban Interface: The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.