

Community Wildfire Protection Plan  
for  
Vineyard Mountain  
Corvallis, Oregon  
August 2007



Prepared by



**Forest Restoration Partnership**

Vineyard Mountain Community Wildfire Protection Plan

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## Chapter 1 - Introduction

This plan has two main goals. First, to provide silvicultural prescriptions that can reduce the risk of property loss, due to wildland fire, in the Vineyard Mountain subdivision. Second, to promote a better understanding of how to take preventative measures that may help prevent the loss of structures during a wildland fire. This plan also discusses the potential for both crown fires and surface fires in the Vineyard Mountain subdivision, and makes recommendations to help reduce the risk of property loss in the case of such fires.

Fire plays an important role in our forested ecosystems. Historically oak woodland and savanna forest types had a very short time interval between the occurrences of fires. With the current and past fire suppression efforts we have dramatically increased this interval. By suppressing fires quickly we have changed these ecosystems, allowing coniferous trees, such as Douglas-fir, to establish and overtop the oak trees that once dominated the landscape. In some cases these forests have been altered to the point where oak is no longer the primary tree species and the understory is now dominated by woody shrubs, rather than the grass and forbs once present.

Besides the change in the actual forest we have also seen an increase in the amount of people that are residing close to the forest, in the wildland urban interface (WUI). Due to the increase of humans in these areas there is a significant increase in the risk of property and structure loss due to a wildland fire.

A crown fire needs both conditions that initiate the fire and those that will sustain it through a forest stand. Factors that influence the initiation of a crown fire consist of crown base height and the heat of ignition. Factors that influence whether or not a crown fire can sustain in a stand consist of canopy bulk density, canopy cover, and forest cover type. There are also two main types of crown fires: passive and active crown fires. A passive crown fire is one that torches individual trees and does not make a “run” through the forest, by passing from one tree to another. An active crown fire is one that “runs” through the forest, spreading from one tree to another, and often results in a stand replacing fire, completely removing the overstory. Active crown fires have historically been the type of fires that occur in western Oregon and Washington forested landscapes. These forested landscapes consist of an overstory dominated by coniferous trees, such as Douglas-fir, and an understory dominated by woody shrubs and small hardwood trees, such as bigleaf maple and red alder.

A surface fire is a fire that runs through the understory of a forest, but can be just as dangerous, to residents, as a crown fire in the wildland urban interface. Surface fires are a result of fine fuels and woody shrubs burning and can bring a fire right up to a house. These fires can quickly carry to a house if defensible parameters are not met by a homeowner. In the right conditions, a surface fire can also result in a crown fire. Ladder fuels, fuels that reach from the ground up into the canopy, can quickly cause a surface fire to carry up into the canopy and ignite a crown fire. Surface fires have historically occurred in forested landscapes of the foothills to the Oregon Coast Range, such as oak woodland and oak savannas.

## ***Organization of the Plan***

This plan is organized into six chapters.

### **Chapter 1 – Introduction**

This chapter states the goals of this plan and describes how fire plays a role in a forested ecosystem.

### **Chapter 2 – Objectives**

This chapter provides the objectives of the plan.

### **Chapter 3 – Background**

This chapter describes the historical and current state of the forests and the historical use of fire in the area of the Vineyard Mountain subdivision. It also describes the climate, population, and development in the area of the project. Lastly, this chapter defines what a Community Wildfire Protection Plan is and why a community should develop one. It also describes who was involved in developing this plan.

### **Chapter 4 – Methods**

This chapter describes the methods used to analyze the forest areas around Vineyard Mountain and determine the potential for a fire to occur. It also illustrates how individual structures were assessed to determine how emergency responders would protect each structure.

### **Chapter 5 – Recommendations and High Priority Sites**

This chapter gives specific recommendations on how to reduce the amount of hazardous fuels in the project area. It also provides ways for a homeowner to help protect their own property in the case of a fire. Finally, it discusses different evacuation routes for residents in the case of a fire, and provides a way to inform residents of these routes.

### **Chapter 6 – Conclusion**

This chapter reiterates that initial treatments are not going to be enough, constant monitoring and re-evaluation will be necessary to maintain a fire-safe community.

## Chapter 2 - Objectives

The objectives of this plan are to:

- Increase public understanding of living in a fire vulnerable environment.
- Provide landowners, within the Vineyard Mountain subdivision, with information of potential fire behavior in their community.
- Identify areas that may produce extreme fire behavior under various weather conditions.
- Develop silvicultural treatments that may reduce the risk of extreme fire behavior and that develop a fire resilient landscape.
- Identify high priority areas and develop silvicultural prescriptions for immediate treatment.
- Provide landowners with resources that explain preventive measures that they can take to help reduce the risk of structure loss.

## **Chapter 3 - Background**

### ***Description of Project Area***

The Vineyard Mountain subdivision is located in Benton County, Oregon and is in close proximity to the City of Corvallis. It is located approximately two miles north of Corvallis, on of Lewisburg Road, and is approximately 330 acres. The subdivision is situated on south and east-facing slopes, which tend to be much drier than other slopes, in the eastern foothills of the Oregon Coast Range and is bordered to the north by the Oregon State University McDonald Forest. Figure 1, on the next page, shows the location of Vineyard Mountain in relation to Corvallis.

### ***Climate***

The climate for this area consists of cool, wet winters and warm, dry summers. Average temperatures range from 41° F in the winter to 65° F in the summer. Extreme temperatures during the summer can result in high temperatures above 90° F for an average of 5-15 days a year. Winter low temperatures can drop below zero, but only do on an average of once every twenty-five years. Mean annual precipitation for the subdivision ranges from 50-70 inches (Natural Resources Conservation Service, 2007).

Winds in the Willamette Valley can also be very erratic and play an important role in the case of a fire. East winds can dry fuels out much quicker and, during a fire, can cause the fire to spread very rapidly throughout the area.

### ***Population***

Currently Vineyard Mountain has approximately 100 homes with families and retirees residing in the subdivision. The city of Corvallis and the surrounding area has grown very rapidly over the past 10 years and is expected to continue growing in the near future. An increase in the number of people living in subdivisions, similar to Vineyard Mountain, increases the importance of educating the landowners about living in a fire vulnerable environment.

### ***Development***

Over the next ten years the city of Corvallis is expected to continue to grow. With this growth more people will have the desire to live near the city in the wildland-urban interface (WUI), the area that is developed on the edge of the surrounding forests. The Vineyard Mountain subdivision is a perfect example of a WUI. With the increase of people living in and around a WUI, public responsibilities of living in a fire vulnerable ecosystem will need to be understood by everyone.

# Location of Vineyard Mountain in Relation to Corvallis and the OSU College Forest

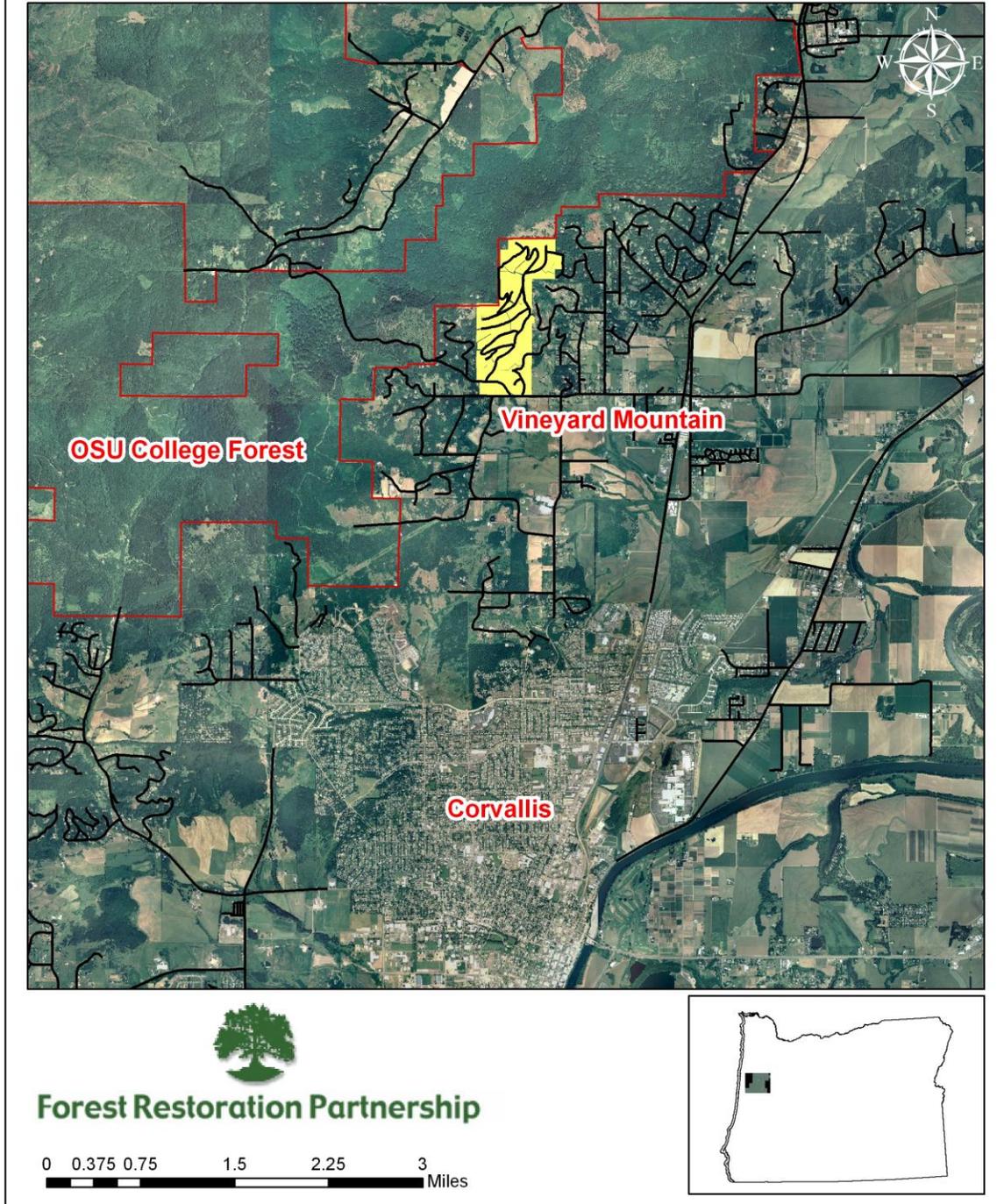


Figure 1: Location of Vineyard Mountain

## ***Historic Forest Types and Presence of Wildland Fire***

Forests in the area of Vineyard Mountain are quite productive due to the mild temperatures, amount of precipitation, and deep, rich, fertile soils. Historically this landscape was dominated by oak woodland and savanna with an understory consisting of grasses and forbs. These landscapes tended to burn on a regular basis with low intensity surface fires. This area was also heavily influenced by the Kalapuya Indians. The Kalapuya's frequently burned this area to make the landscape more favorable to elk and deer, which they hunted for food. With the inhabitant of Euro-Americans, the native tribes moved on and with them so did there constant fires. With the loss of these fires, conifer trees have established and have overtopped the oak trees. The understory has changed from grasses and forbs to an understory with more woody shrubs and dead and down wood. These types of forests are similar to those of the Oregon Coast Range and have historic fire return intervals of 150-300 years. These fires also tend to be that of large stand replacing fires, rather than the low intensity, frequent fires of the oak woodland forest type.

## ***What is a Community Wildfire Protection Plan***

A community wildfire protection plan brings together information that assesses the risk of a fire based on current forested conditions, displays the potential structure loss if a fire were to occur, and develops silvicultural treatments that could help to prevent and protect the community from a wildland fire. Although there is no current law requiring a wildfire protection plan, it allows a community to coordinate efforts that will allow everyone to get involved in the protection of their homes. These efforts consist of fuel reduction treatments, developing a defensible space around structures, and continued maintenance of the surrounding forested areas.

The Oregon Forestland-Urban Interface Fire Protection Act of 1997 (also referred to as Senate Bill 360), recognizes land that is located within an urban, or suburban, area that is vulnerable to a fire. This Act engages property owners to assist in achieving the goal of reducing a fire vulnerable area back towards a more fire resilient area. Although Benton County has not yet identified these areas, this plan has been developed in anticipation of the identification of such fire vulnerable areas in Benton County. This plan also allows the community to have a written plan for applying, and being approved, for National Fire Plan grants. These grants can be obtained to “reducing hazardous fuels that may threaten communities and natural landscapes within the wildland-urban interface on non-federal land (Pacific Northwest National Fire Plan).”

## ***The Planning Process***

This plan was developed by the cooperation of the Corvallis Fire Department, Oregon Department of Forestry, Benton County, and Forest Restoration Partnership (a non-profit organization that promotes the conservation and restoration of declining forest habitats on private lands in the Western United States.)

The Corvallis Fire Department performed a structure analysis of houses throughout the subdivision, the Oregon Department of Forestry distributed a Living with Fire™ brochure to residents within the subdivision, and Forest Restoration Partnership performed the fuels analysis, developed fuel reduction treatments, and prepared the written plan.

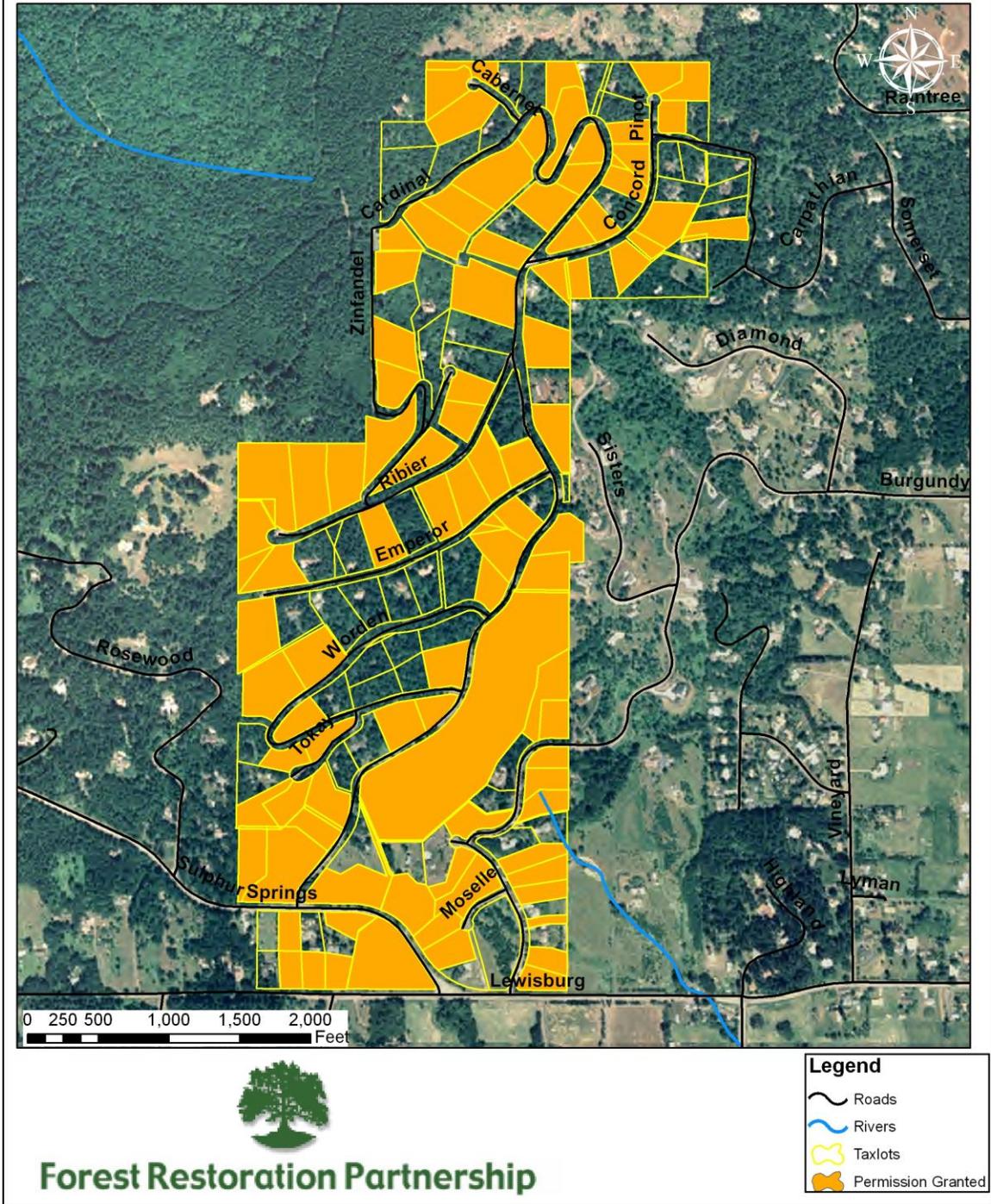
During the months of January and February 2004 city planners in Corvallis and Philomath, the Philomath and Corvallis Fire Departments, Forest Restoration Partnership, and the Oregon Department of Forestry met three times to discuss which subdivisions should be selected to receive the grant money. Mary's River Estates was selected from the Philomath Fire District and Vineyard Mountain from the Corvallis Fire District.

An Interagency National Fire Plan Community Assistance Grant, through the Bureau of Land Management, was awarded in September 2005. The grant was award to development comprehensive fire plans that will help reduce the risk of a fire in Mary's River Estates, located in the Philomath Fire Protection District, and Vineyard Mountain, located in Corvallis Fire Protection District.

On May 11, 2006 a letter was mailed to all property owners within Vineyard Mountain describing the grant and asking for permission to enter their land for fuels analysis. The letter also included a questionnaire that allowed the landowner to specify whether or not they would allow for Forest Restoration Partnership to enter their property. The letter and questionnaire can be seen in the Appendix as Attachment 1 and 2. A map, showing the landowners that granted permission for Forest Restoration Partnership to enter their property, can be seen on the next page.

A final meeting occurred on September 29, 2007 to review the first draft of the plan. In attendance were representatives from Philomath Fire and Rescue, Forest Restoration Partnership and the Oregon Department of Forestry. The plan was discussed in detail and a timeline was established to finish the plan. Other items discussed at the meeting were organizing a community meeting once the plan was finalized and putting out a mailing to residents explaining the plan and the results of the structure and fuels analyses.

## Landowners that Granted Permission for Forest Restoration Partnership to Enter their Land



**Figure 2: Landowners that Granted Permission to Enter their Property**

## Chapter 4 - Methods

### *Wildfire Risk Assessment*

#### **Stand Typing**

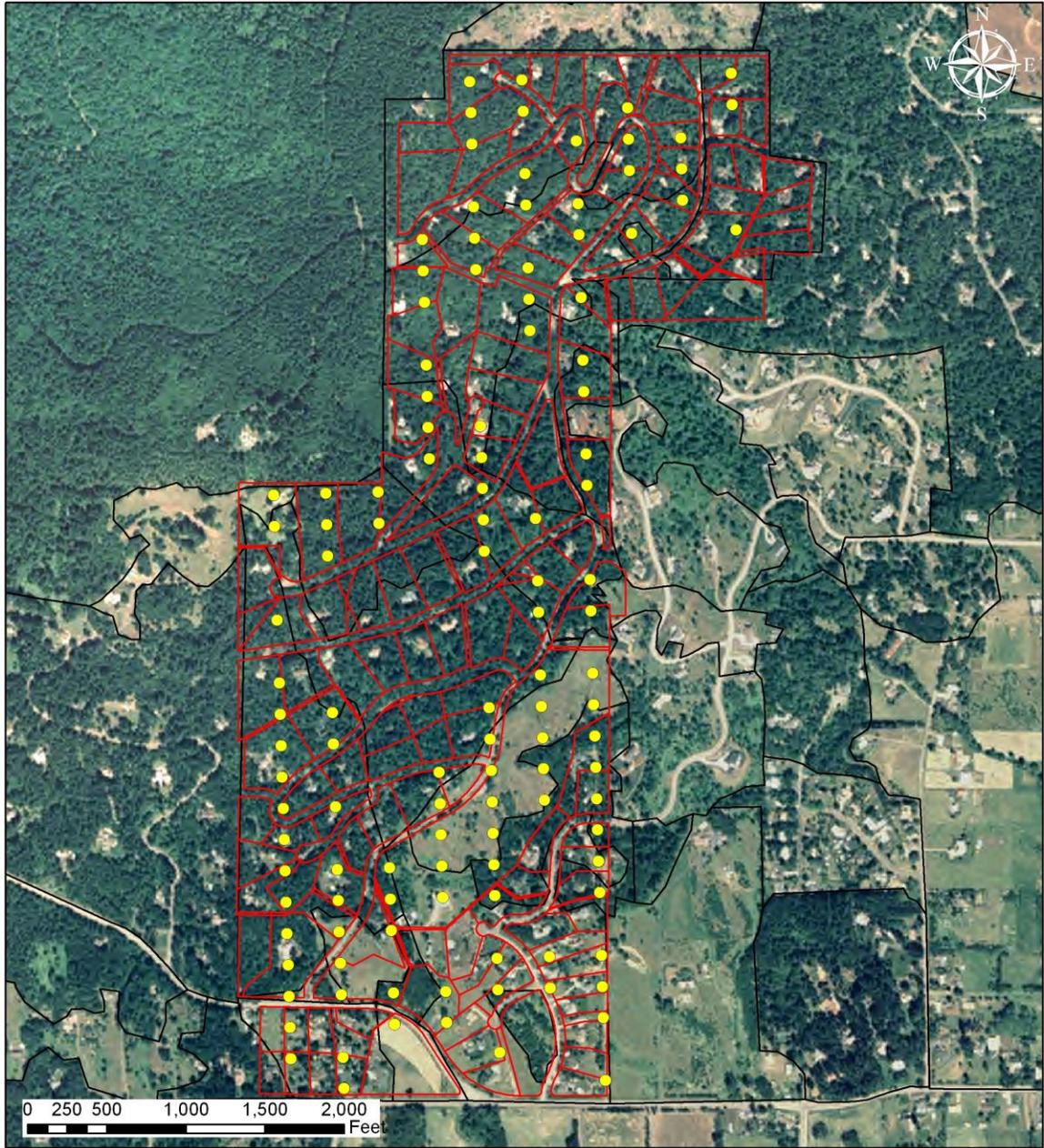
Using the subdivision boundaries and aerial photographs, each subdivision was divided into stands based on the forest cover types. Forest cover types are defined by primary vegetative cover, secondary vegetative cover, density, estimated age, and size class. Stands were then digitized as polygons using the GIS software ArcGIS 9.2™. See Attachment 3 for a more detailed description of stand types used.

#### **Inventory Procedures**

Using the forest stands and subdivision boundaries, an inventory plot grid was established using GIS. Each plot consisted of a variable-radius plot for trees greater than 5.5” diameter at breast height (DBH), and a 1/100<sup>th</sup> acre fixed-radius plot for trees less than 5.5” DBH. For each tree on a plot, species, DBH, crown height (base of the tree to the first live branch), and crown class (dominant, co-dominant, intermediate, or suppressed) were recorded. On the variable-radius plots, heights were recorded for one tree per species per plot. On the fixed-radius plots, heights were recorded for every tree. A fuel model call was also made at each plot. See Attachment 2 for a complete explanation of the inventory procedures.

Before any inventory data was collected, landowners were contacted to ask for their cooperation with the project. Data was only collected where landowners granted permission for technicians to access the property. A total of 143 inventory plots were established for data collection. Figure 4, on the next page, shows a map of the inventory plot locations.

# Inventory Plot Locations



**Forest Restoration Partnership**

**Legend**

- Inventory Plots
- ⬡ Taxlots
- ⬡ Stands

**Figure 3: Map of Inventory Plot Locations**

## **Fuel Model Calls**

Fuel model calls were determined as defined by Scott and Burgan's *Standard Fire Behavior Models: A Comprehensive Set for use With Rothermel's Surface Fire Spread Model (2005)*. The following subset of Scott and Burgan's fuel models were determined to be appropriate for the inventory areas:

- GR4: Moderate Load, Dry Climate Grass (Dynamic)
- SH5: High Load, Dry Climate Shrub
- TU1: Low Load, Dry Climate Timer-Grass-Shrub (Dynamic)
- TU5: Very High Load, Dry Climate Timber-Shrub
- TL1: Low Load Compact Conifer Litter
- TL3: Moderate Load Conifer litter
- TL5: High Load Conifer Litter
- TL9: Very High Load Broadleaf Litter

## **Fire Behavior Modeling and GIS Analysis**

Once the inventory data was collected it was analyzed with other GIS layers and a fire behavior modeling software package, *FlamMap*<sup>TM</sup>, to predict where there is a potential for surface fires and crown fires. *FlamMap*<sup>TM</sup> utilizes raster data from the GIS layers and a 10 meter Digital Elevation Model (DEM) to model the fire behavior for each 10-by-10 meter cell, independent from all adjacent cells.

Slope, aspect, and elevation were derived from the DEM and used to define the project area. Fuel model, canopy cover, crown base height, and canopy bulk density were derived from the inventory data. An additional data compiling program, designed by Donald W. Carlton at Fire Program Solutions, was utilized to take the inventory data and generate raster datasets that could be used in *FlamMap*<sup>TM</sup>. Mr. Carlton personally performed this analysis using the program *CM3 Batch*<sup>TM</sup>. Mr. Carlton's company, Fire Program Solutions, LLC, provides "state-of-the-art methods, processes and analytical support to examine fire management program issues (Fire Program Solutions)."

Three different fuel moisture scenarios were used to model the fire behavior. Each of these fuel moisture scenarios contained values for 1, 10, and 100 hour fuel moisture, herbaceous fuel moisture, and woody fuel moisture. The three fuel moisture scenarios consisted of moderate weather conditions (16-89<sup>th</sup> percentile), high weather conditions (90<sup>th</sup> percentile), and extreme weather conditions (97<sup>th</sup> percentile). Wind speeds, acquired from the Village Creek Fire and Weather Station (station number 352547), were determined for winds twenty feet above the forest canopy in each scenario. The Village Creek station was used due to its close proximity to Vineyard Mountain and its longer span of historical weather data (1985-2006). It is located approximately 40 miles southwest of the subdivision and is maintained by the Bureau of Land Management (BLM). See Attachment 5 for detailed values of each fuel moisture scenario.

To determine the high priority sites, the crown fire output, from *FlamMap*<sup>TM</sup>, was converted to a GIS layer and overlaid on the stand type map and the taxlot information. The high priority sites were then found based on stand types and specific areas that were more

susceptible to crown fires. These sites were then considered as primary target areas to reduce fuel loads and are discussed in greater detail in the “Recommendations and High Priority Sites” section of this plan.

It is important to note that *FlamMap*<sup>TM</sup> does not predict the potential for ignition in the analysis area. Instead, the program assumes that an ignition has taken place in every cell analyzed, and then makes fire behavior predictions based on slope, aspect, fuel model, canopy cover, crown base height, canopy bulk density, and fuel moisture values. In addition, *FlamMap*<sup>TM</sup> should be used only as a general fire behavior modeling tool, and the results provided by this tool should not be interpreted as an exact prediction of potential fire behavior under a broad range of conditions. The prescriptions we have developed using the information provided by this program were not modeled to determine changes in fire behavior as a result. They were instead based on existing fuel conditions, and widely accepted practices which can be used to change these conditions.

### ***Structure Vulnerability***

During the month of August 2006, the Oregon Department of Forestry conducted a door-to-door distribution of “Living with Fire, A Guide for the Homeowner,” a pamphlet with information pertaining to what a homeowner can do to help protect their property from a fire. During this same time period, the Corvallis Fire Department completed a structure assessment of Vineyard Mountain. A computer based structure triage checklist, FireSurvey<sup>TM</sup> designed by Alsea Geospatial, Inc., was used to determine the hazard rating for each structure. The following questions were assessed for each structure within the subdivision:

- Is the driveway longer than 200 feet?
- Number of driveway entries to house?
- Condition of the driveway?
- Is the roof made of combustible-asphalt shingles or wood?
- Is the siding made of combustible-wood or shingles?
- Are there trees overhanging the roof?
- What is the distance between the structure and any vegetation?
- Is there fire service access with a turnaround?
- What is the average percent slope of the property?
- What type of vegetation cover is surrounding the house?
- Are utilities aboveground or belowground?
- Is there an onsite water source?
- Where is the nearest fire resource?
- Is there a fixed fire protection system, such as an in house sprinkler system?

A point total was generated depending on the answer to each of the questions. If the answer to the question made the structure less prone to being destroyed in a fire it received a lower score. For example, if a house has wood shingles it would receive a higher score than one with a non-combustible Class-B alternative shingle. The final rating of the structures fell into one of the four final ratings.

1. Low hazard
2. Moderate hazard
3. High hazard
4. Extreme hazard

The higher the hazard rating the lower priority a house would be, when compared to saving other houses, to save in the case of a fire. For example, a house with a final rating of “Low hazard” would get more firefighting efforts and would have a much higher chance of being saved during a fire than a house that had a final rating of “High hazard.” With limited resources, the fire department and assisting agencies may have to make decisions about which houses they will defend. Since an “Extreme hazard” home will require more effort, they may choose to protect a home with a more favorable rating. This allows them to save the most homes in the community. The ideal situation would be to have all structures with a final rating of “Low hazard”.

## Chapter 5 - Recommendations and High Priority Sites

Recommendations for action are broken into five main categories: access roads and evacuation routes, structure risk, water sources, mitigation of hazardous fuels, and the identification of high priority sites. These recommendations have been prioritized by the Corvallis Fire Department, from highest to lowest, and are as follows:

1. Structure risk/Defensible Space
2. Evacuation Routes
3. Water Sources
4. High Priority Sites
5. Mitigation of fine fuels

### *Access Roads and Evacuation Routes*

The goals of this section are:

- Establish evacuation routes in the case of an emergency.
- Identify a way to make all evacuation routes familiar to residents.

Currently there are two main throughways that provide four different exit routes for Vineyard Mountain. Concord Drive and Burgundy Road are the two throughways, providing two exit routes each. Burgundy Road goes through the southeast part of the subdivision connecting with Lewisburg Road, to the south, and Mountain View Drive, to the east. Concord Drive junctions with Lewisburg Road via Sulfur Springs Road, and Mountain View Drive via Carpathian Drive and Somerset Drive. The primary evacuation route, as to not interfere with incoming firefighting apparatus, is for residents to exit toward Mountain View Drive. The routes exiting to Sulfur Springs Road and Lewisburg Road should only be used if the Mountain View Road exits have been compromised by a fire.

Fire evacuation route signs, similar to tsunami evacuation route signs on the Oregon Coast, should be placed throughout the subdivision. These signs will allow residents to exit the subdivision, in the case of an emergency, in a very timely and efficient manner. This will also help to keep residents from interfering with incoming emergency vehicles as they exit the subdivision. Figure 3, on the next page, shows a map of the evacuation routes.

# Evacuation Routes

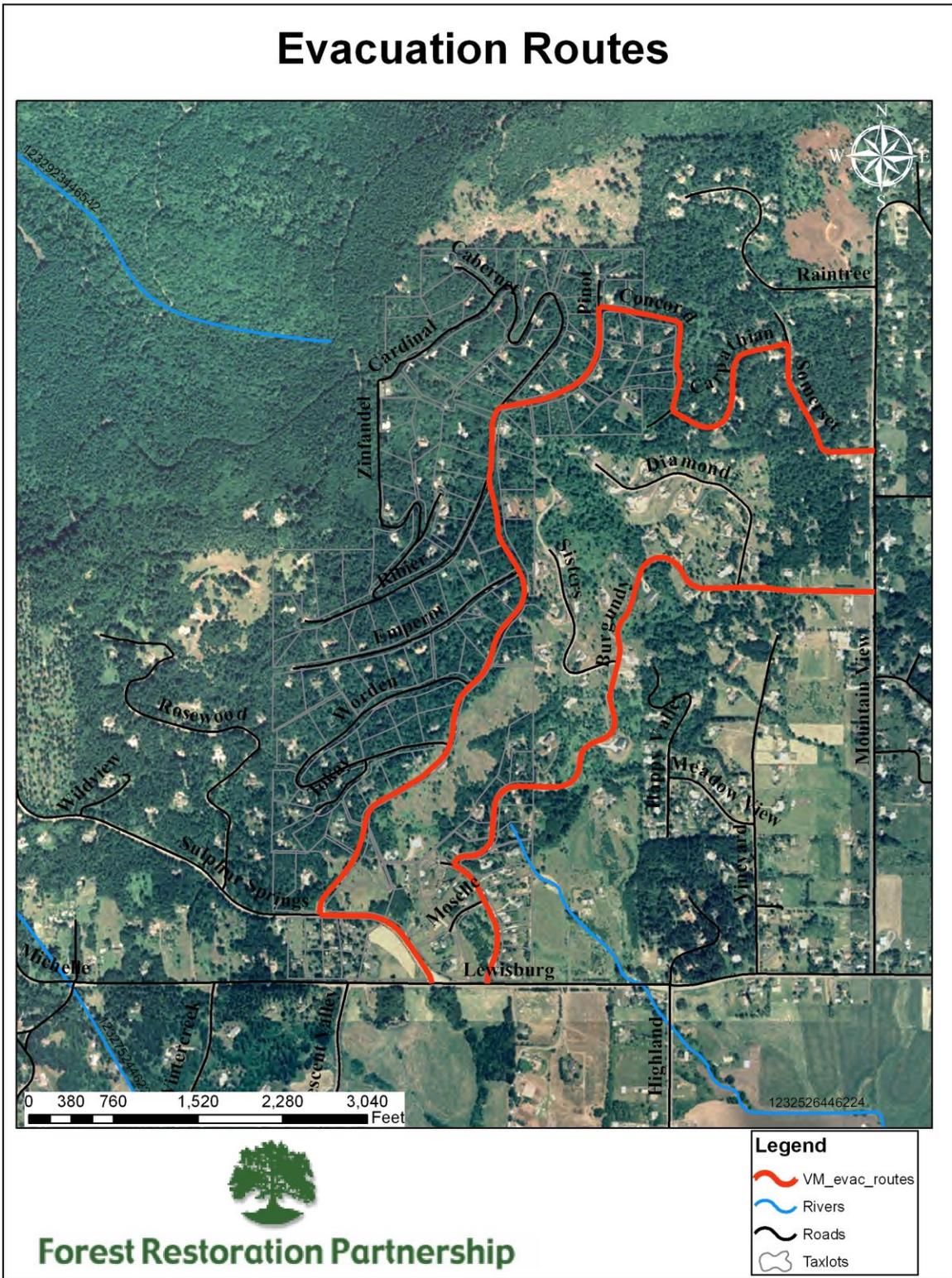


Figure 4: Map of Evacuation Routes

## ***Water Sources***

The goals of this section are:

- Identify where current water sources are located.

Currently there are 10 sources of water for firefighting operations around Vineyard Mountain. These sources consist of hydrants, cisterns, and open draft sites.

There are 10 fire hydrants located at Crescent Valley High School, less than a mile south of Vineyard Mountain. These hydrants are easily accessible and deliver 1,500 gallons per minute (GPM) each. These are the first water sources that would be accessed in the case of a fire on Vineyard Mountain. There is also a hydrant system on Vineyard Mountain, identified with a marker utilizing the National Fire Protection Association. However, these hydrants range from 1,500 GPM to 500 GPM, are concentrated in only a small part of the subdivision, and are not tested regularly. Due to these reasons, the Corvallis Fire Department does not consider the hydrants on Vineyard Mountain as a reliable source.

The next choice in terms of a water source comes from the use of cisterns. Currently there are four cisterns within the Corvallis Fire Protection District in the Lewisburg region. They are located at the Highland Community Church (15,000 gallons), St. Martin the Merciful Orthodox Church (9,000 gallons), Nazarene Church on Highway 99W (48,000 gallons), and Fire Station #6 on Lewisburg Road (30,000 gallons). These sources are easily accessible and provide plenty of water; however, they are more labor intensive and time consuming to use when compared to hydrants.

The open drafts sites are the last choice for use by the Corvallis Fire Department. These sites consist of a pond at 6613 Pettibone Drive, located at the back of the nursery, a private pond at 1225 Kainui, a pool on Vineyard Mountain, a private pond at 2150 NW Jackson Creek Road, and the pond at Peavy Arboretum. These sources are the last option because they have an unknown amount of water source, are much more labor intensive, and can clog the water pumps if the water is dirty.

It is recommended that the hydrants on Vineyard Mountain be updated and tested on a regular basis so that they can be used in the case of a fire.

## ***Structure Risk***

The goals of this section are:

- Educate the public on ways to decrease the risk of property loss in the case of a fire.
- Provide additional resources on living in a fire vulnerable landscape.

Based on the results, of October 2006, from the Oregon Department of Forestry and Corvallis Fire Department fire prevention work, Table 1 shows there are many houses that do not have the recommended defensible space and over three quarters of the structures were determined to have either a high or extreme fire hazard.

**Table 1: Percentage of Houses with each Structure Hazard Rating**

Fire Hazard Rating of Structure	Percent of Houses
Low Hazard	0%
Moderate Hazard	12%
High Hazard	77%
Extreme Hazard	11%

It is recommended that all structures in this subdivision be in compliance with Living with Fire™ practices. Living with Fire™ is a multi-agency organization that educates the public about living in a fire prone environment. The following list of recommendations is from the Living with Fire™ website, <http://www.livingwithfire.info/>. Additional information and resources pertaining to Living with Fire™ and practices can also be found at their website, as well as the Firewise™ Communities website, <http://www.firewise.org/>.

- Excess vegetation on road shoulders is removed.
- Cedar shake roofs are replaced with a non-combustible, Class A alternative.
- Fuels, or other woody material, are chipped or removed immediately after cutting.
- Firewood is piled away from the house, not against it.
- A three-foot fire-free area, with no vegetation, is created on all sides of the house.
- Dead leaves and branches are removed from trees, shrubs, and plants within the home ignition zone (the area within 200 feet of your home).
- Remove leaves and conifer needles from the home ignition zone.
- Prune trees so the lowest branches are 6 to 10 feet from the ground in the home ignition zone.
- Cut back brush and shrubs at least 30 feet from your home.
- Lawn should be kept green to help serve as a fire break.
- Trees are thinned at the edge of the home ignition zone.
- Trees are carefully spaced within the home ignition zone, to help slow the spread of a fire.
- Provide a driveway that is at least 12 feet wide with a clearance of at least 14 feet to provide better access for emergency vehicles.

### ***Mitigation of Hazardous Fuels***

The goal of this section is to:

- Develop silvicultural treatments that can be used to reduce hazardous fuels throughout the subdivision.
- Identify each fire type; active crown fire, passive crown fire, and surface fire, and show where each is on the ground.

In order to reduce the risk of property loss in an area of high population, treatments should be designed to reduce the spread of a surface fire within 100 feet of a structure and reduce the threat of a crown fire over the entire landscape. To do this vegetation can be treated in one of two ways, or a combination of the two. The first would be to reduce the amount of cover in the understory, mainly through dead fuels (dead shrubs or standing or down dead trees) and ladder fuels. This will help to prevent a surface fire from becoming a crown fire. The second way would be to reduce the amount of cover in the overstory. This can reduce the crown fire behavior; however it can also increase the surface fire behavior through increasing winds that dry out understory fuels more rapidly. The following silvicultural treatments are recommended with the idea to keep a fire out of the canopy and to prevent extreme fire behavior. These treatments are also written to begin the restoration of oak woodland and oak savanna forest types. However, these treatments alone will not be sufficient to accomplish these goals; additional maintenance of the stand will need to occur, as described in the “Continued Maintenance of Fine Fuels and Understory Vegetation” section.

### **Treatment #1: Reduce Understory Fine Fuels**

Reducing the understory fine fuel load can be accomplished by brush mowing and masticating the understory. This can be accomplished by hand; however, due to the extensive labor of doing this by hand it can also be accomplished by using a machine with a masticating head. The purpose of this kind of treatment is to reduce and redistribute the amount of fine fuels on a given site. It should include areas with a high amount of fine fuels, such as woody shrubs in very close proximity to structures and/or roads. This treatment can also be used to reduce the amount of activity fuels (slash) after a thinning. Broadleaf shrub cover will not modify fire behavior during a crown fire in extreme weather conditions; however, they still should be removed in some forest cover types. For example, in an oak woodland/savanna, grass and forbs are desired over a shrub dominated understory. Grass and forbs will result in a faster moving fire, with a much lower intensity and severity than an understory dominated by shrubs. Broadleaf shrubs can also reduce fire behavior. Broadleaf shrubs can modify the microclimate on a site by increasing the humidity in the understory through transpiration and by increasing the amount of shade on site.

### **Treatment #2: Thin from Below**

Thinning from below is an effective treatment for stands that contain a high amount of coniferous trees in the smaller diameter classes. These trees tend to have crowns that are closer to the ground and act as ladder fuels. This is especially true of grand fir, a shade tolerant species that can have a crown base just off the forest floor. This treatment will result in a higher average crown base height and a reduction in crown bulk density for a given stand. It can also reduce the amount of tree mortality in a stand by removing the trees that are in the intermediate and suppressed crown class stages. If these trees were to stay in a stand and die, they would become ladder fuel in the form of a standing dead tree or by increasing the amount of dead wood on the forest floor.

### **Treatment #3: Pruning and Tree Removal**

In some stands it can be more effective to assess crown fire potential on a tree-by-tree basis. In stands that have individually grown trees, with live crowns extending to the ground, pruning can be used to raise the height of the crown and reduce the risk of a fire getting into the crown. This treatment can be used in stands that have very few or no trees in the smaller diameter classes, but still have a high potential for a crown fire to exist.

### **Identification of each Fire Type**

The maps on the next three pages show the three different fire types across the subdivision at the three different weather scenarios; moderate, high, and extreme. The results are from the *FlamMap*<sup>TM</sup> analysis. The different weather condition scenarios are described in the “Fire Behavior Modeling and GIS Analysis” section of this plan.

Areas that are within the surface fire and passive crown fire ratings should be individually assessed to remove understory fuels and ladder fuels. Areas that are modeled as an active crown fire are discussed in greater detail in the “High Priority Sites” section of this plan.

# Fire Behavior with Moderate Weather Conditions

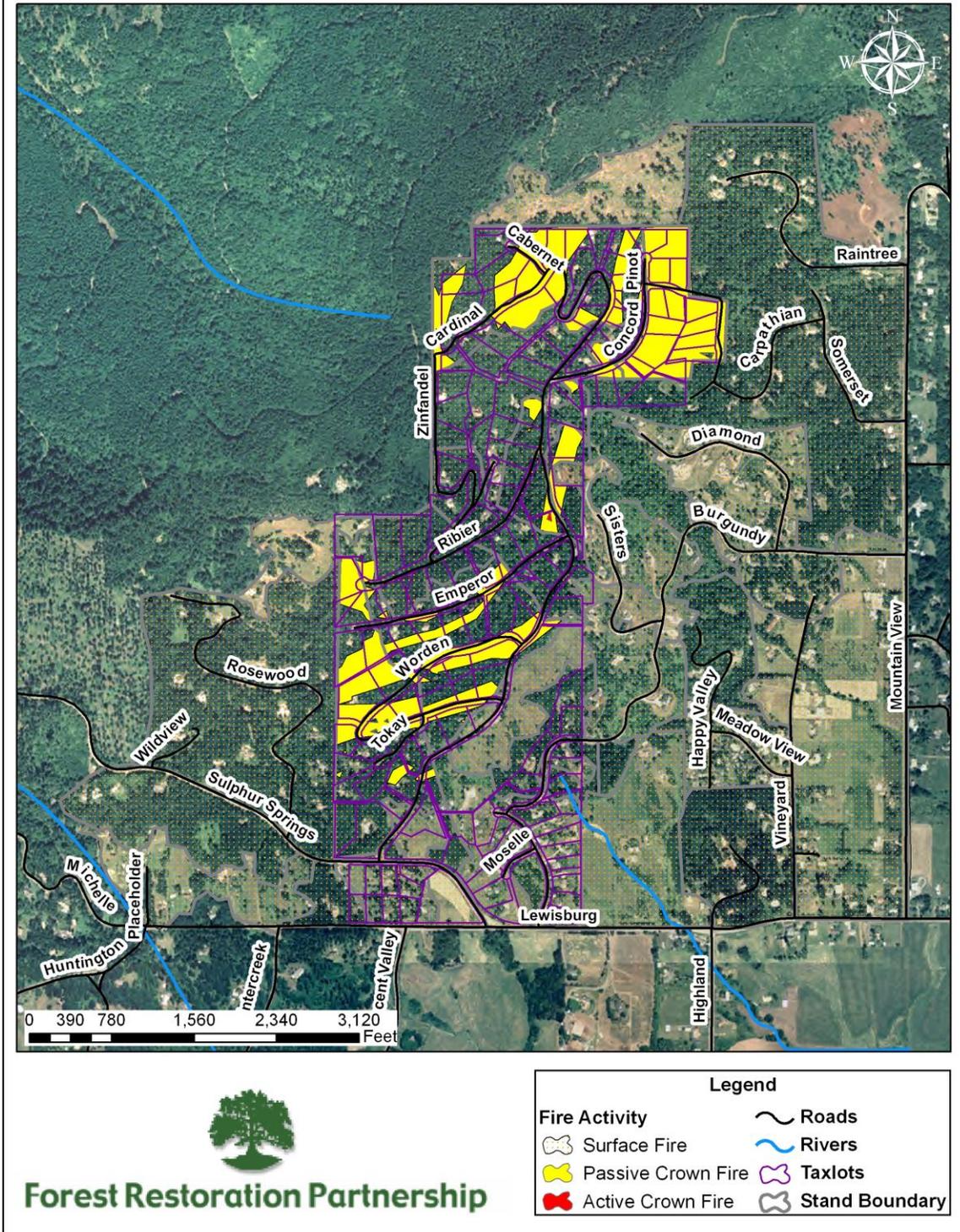


Figure 5: Fire Behavior with Moderate Weather Conditions

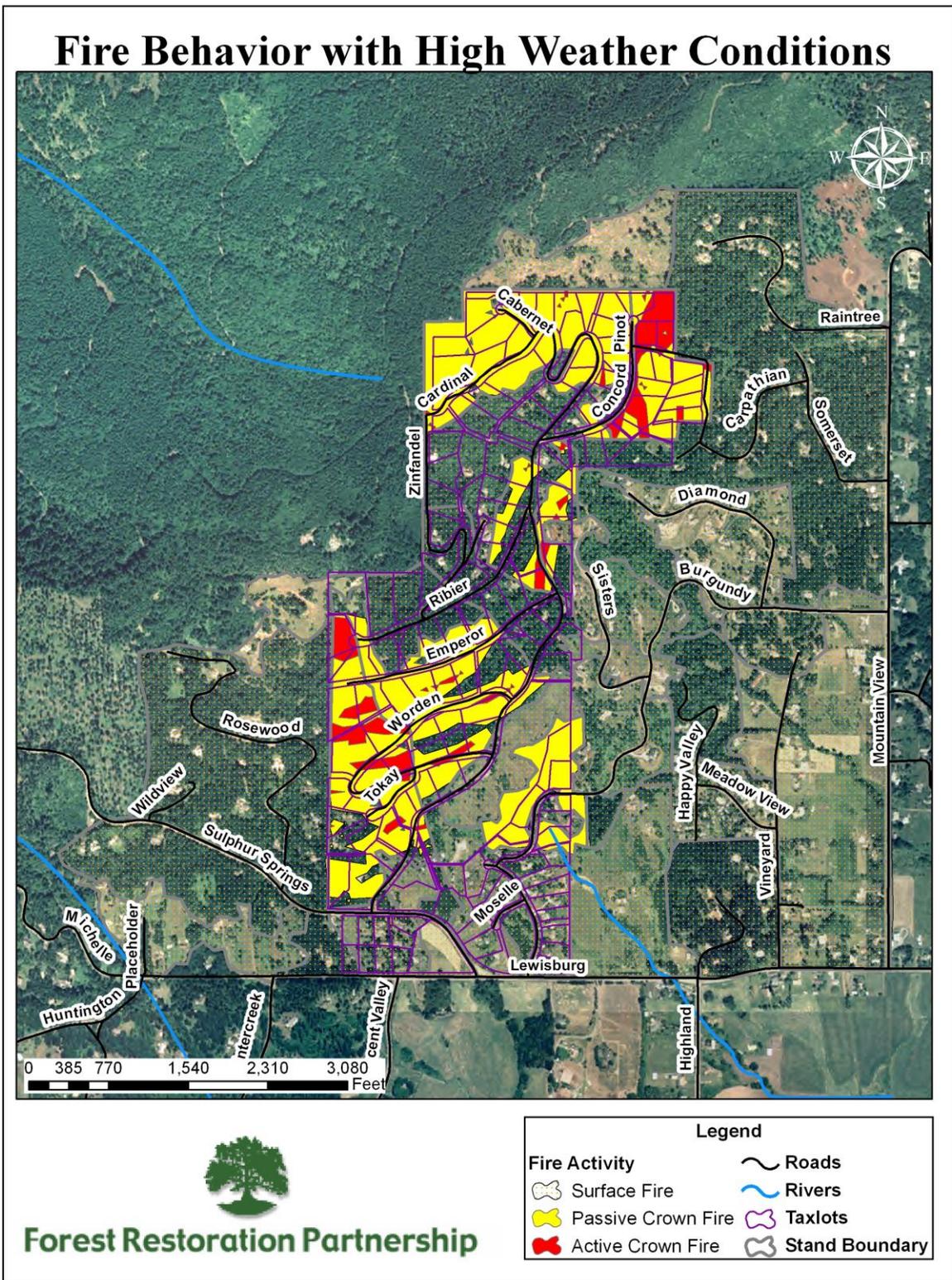


Figure 6: Fire Behavior with High Weather Conditions

# Fire Behavior with Extreme Weather Conditions

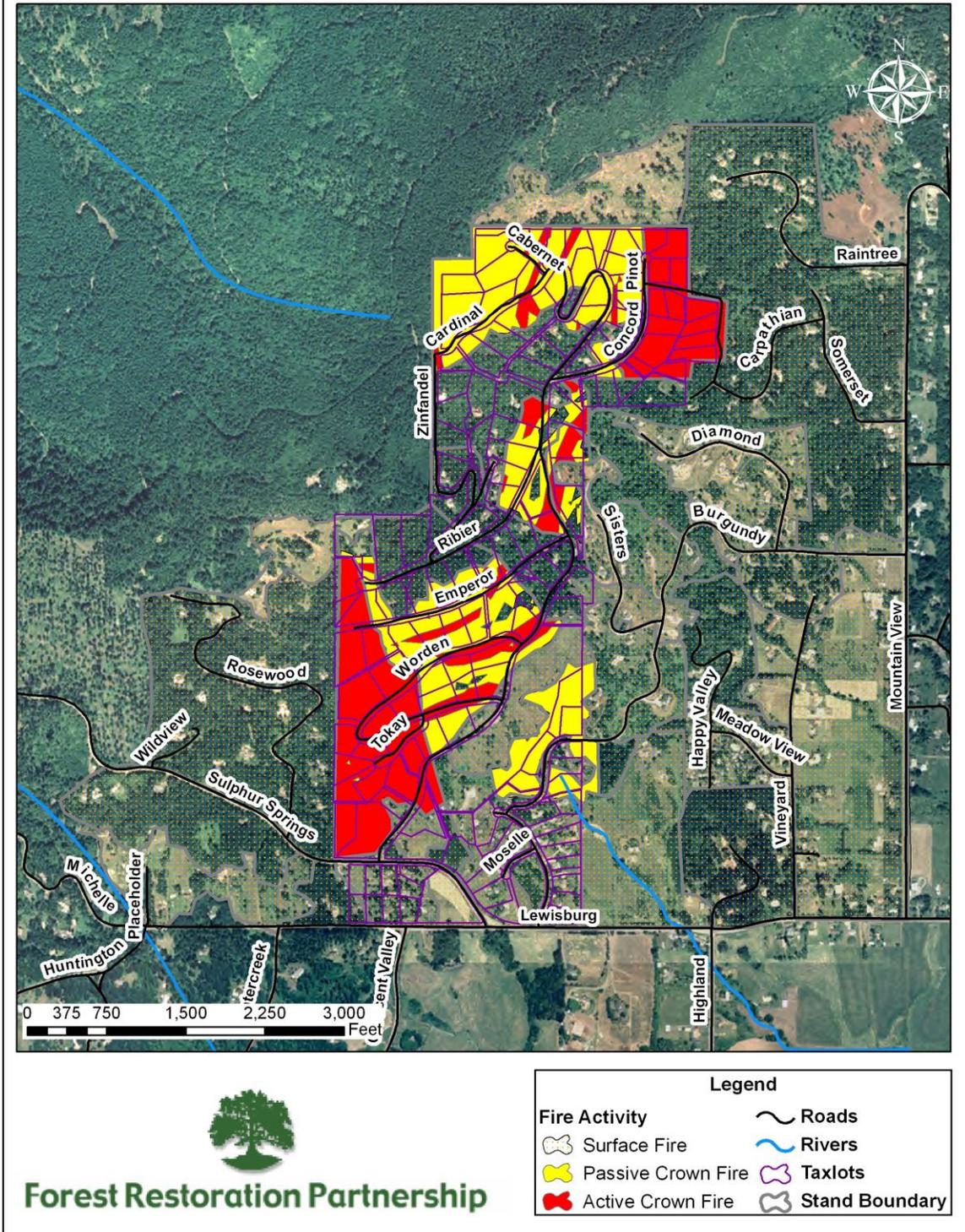


Figure 7: Fire Behavior with Extreme Weather Conditions

## ***High Priority Sites***

The goals of this section are:

- Identify high priority sites that are in need of immediate treatment due to the potential for a crown fire.
- Develop a combination of the silvicultural treatments for each high priority site

The following recommendations are being made based on the potential for a crown fire to exist, as modeled by *FlamMap*<sup>™</sup>. The treatments describe ways that can reduce the risk of a crown fire. Although the treatments are prescribed for an entire stand, it does not necessarily mean that the entire stand needs to be treated. Treatments should be focused toward slopes that are more prone to fires, south- and east-facing slopes. Figure 4, on the next page, shows a map with stand numbers.

See Attachment 6 for additional information on how to identify tree species that are discussed in the stand descriptions.



### **Stand 0202**

This stand contains a mix of bigleaf maple, Douglas-fir, grand fir, Oregon white oak, and Pacific madrone. However, Douglas-fir accounts for over half of the 211 square feet of basal area per acre, a measure of stand density. The recommended treatment for this stand consists of a thinning from below that removes all Douglas-fir less than 10 inches in diameter, at breast height. Subsequent brush mowing and mastication, or piling and burning of slash after the treatment is also highly recommended, as the removal of overstory trees will contribute large amounts of fine fuels, in the form of timber litter, to the forest floor.

### **Stand 0704**

This stand is primarily composed of Douglas-fir with smaller components of bigleaf maple and Pacific madrone. Over half of the 227 square feet of basal area per acre is composed of Douglas-fir in the 12-16 inch diameter class. The forest inventory data does not show any Douglas-fir in the smaller diameter classes, which leaves minimal opportunity to reduce hazardous fuels by thinning from below. The recommended treatment for this stand consists of brush mowing and masticating the understory, as well as pruning or removal of individual trees with excessively long crowns.

### **Stand 1002**

This stand is composed of bigleaf maple, Douglas-fir, and grand fir. The current stand density is 128 square feet of basal area per acre, with roughly one third accounted for by Douglas-fir in the 20-24 inch diameter class. The recommended treatment for this stand consists of removing all the grand fir in the 4 inch diameter class, to reduce ladder fuels, followed by brush mowing, mastication, and pruning or removal of individual trees with excessively large crowns.

### **Stand 1101 and 1102**

These stands are composed of bigleaf maple, Douglas-fir, grand fir, and Oregon white oak. Douglas-fir and grand fir, over 16 inches in diameter, account for over 75% of the 110 square feet of basal area per acre. Due to the small size of these stands, they would be most effectively treated by identifying individual trees that are sources of ladder fuels, and pruning or removing those trees.

### **Stand 1301**

This stand is predominantly composed of Douglas-fir, with small components of bigleaf maple and Oregon white oak, and has 129 square feet of basal area per acre. The recommended treatment for this stand consists of a thinning from below that removes all Douglas-fir less than 10 inches in diameter and pruning or removing individual trees with excessively large crowns. This would only reduce the stand density by 15%, but would accomplish the goal of raising canopy base height. Subsequent brush mowing and mastication, or piling and burning of slash is also recommended, as the removal of overstory trees will undoubtedly contribute large amounts of fine fuels, in the form of timber litter, to the forest floor.

### **Stand 1401**

This stand is composed of bigleaf maple, Douglas-fir, grand fir, Oregon white oak, and Pacific madrone and has a stand density of 140 square feet of basal area per acre. Although this stand is isolated from other forest stands, by fields and roads, the *FlamMap*<sup>TM</sup> analysis shows that it still has a high potential for a passive crown fire. The recommended treatment for this stand consists of a light thinning that would remove 50% of the Douglas-fir less than 10 inches in diameter, as well as pruning of trees with longer crowns. Subsequent brush mowing and mastication, or piling and burning of slash is also recommended, as the removal of overstory trees will undoubtedly contribute large amounts of fine fuels, in the form of timber litter, to the forest floor.

### **Stand 1501 and 1502**

These stands are composed of bigleaf maple, Douglas-fir, grand fir, Oregon white oak, and Pacific madrone. Douglas-fir accounts for over half of the 130 square feet of basal area per acre, while bigleaf maple and Oregon white oak combine to make up the majority of the remaining half. The recommended treatment for this stand consists of removing all Douglas-fir less than 10 inches in diameter, and potentially removing all grand fir, which is only a minor component of these stands. Brush mowing and mastication is also highly recommended, not only to mitigate post-treatment litter loads, but to reduce the high litter and brush component already present in these stands.

For additional information contact:

- Forest Restoration Partnership (541) 929-4377
- Oregon Department of Forestry (541) 929-3266
- Corvallis Fire Department (541) 766-6961
- Oregon Department of Agriculture Grant Resources  
<http://www.oregon.gov/ODA/grants.shtml>

### ***Continued Maintenance of Fine Fuels and Understory Vegetation***

The goals of this section are:

- Explain the importance of continued maintenance throughout the life of the forest.
- Provide ways to maintain desired forest conditions.

After the completion of these immediate treatments, actions should be taken to maintain stands in a manner that keeps fine fuels to minimal build-up. Ways to accomplish this consist of brush mowing, prescribed fire, or individual tree removals. Keeping fuels from coming back after treatment will maintain a stand from returning to its current state and will help to reduce the risk of property loss in the long run. These maintenance activities should occur in both the high priority sites and all other sites throughout the subdivision. Fine fuels and dead wood will accumulate over time and need to constantly be monitored to ensure that a surface fire does not get out of control and develop into a crown fire.

Actions should also take place to maintain a lower basal area and lower stocking levels (trees per acre) in the overstory. This should be accomplished by maintaining a forest inventory

on all properties. This inventory can provide information such as basal area, volume, canopy bulk density, crown base height, and canopy cover. By maintaining a lower basal area and a lower stocking level the potential for an active crown fire to occur may decrease.

One way to accommodate these maintenance activities would be to schedule annual clean-up days. These days should be scheduled in the spring, after the winter rains have ceased and are a way to remind residents of the importance of maintaining a clear space around their homes before the fire season begins.

With these efforts, as well as those described in the “High Priority Sites” section, Vineyard Mountain will lower the risk of a catastrophic fire, which could burn down houses, from occurring within the subdivision.

## Chapter 6 – Conclusion and Action Item List

It is important to remember that the initial treatments of the high priority sites are just the beginning of protecting Vineyard Mountain from a fire. Continued efforts, through long term maintenance of the forest and Living with Fire™ strategies near structures, will be necessary to help protect residents from property loss in the case of a fire.

Below is the list of recommendations with suggested implementation dates.

1. Establish a Defensible Space around Structures – Begin implementing with an inaugural “Spring Clean-Up Day” during the spring of 2008.
2. Evacuation Route Signs – Notify residents of the different routes immediately and begin installing evacuation route signs during the summer of 2008.
3. Water Sources – Begin determining what each water hydrants capabilities are, on Vineyard Mountain. During the summer establish a schedule to test these hydrants on a regular basis and begin updating them during the fall of 2008.
4. Treatments of High Priority Sites – Begin implementing the specific treatments for the High Priority Sites during the summer of 2008.
5. Mitigation of Fine Fuels – Begin removing fine fuels throughout the subdivision after specific treatments for the High Priority Sites. Finish removing fine fuels during the 2009 Spring Clean-Up Day.

## References

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FlamMap™ Version 3.0 software package. 2006.

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FireSurvey™ software package. 2005.

Firewise™ Communities. 2007. <http://www.firewise.org/>.

Living with Fire™. 2007. <http://www.livingwithfire.info/>.

Natural Resources Conservation Service. 2007. <http://www.nrcs.usda.gov/>.

Pacific Northwest National Fire Plan. November 2006. <http://www.nwfireplan.gov/>

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# Attachment 1

Letter mailed on May 11, 2006

Owner  
Address  
City, State Zip

**RE: Tax lot #**

The Corvallis Fire Department along with the Forest Restoration Partnership has been awarded a National Fire Plan grant that would be able to assist our community in the creation of a community fire plan. The tax lot referenced above is within the Vineyard Mountain community and is eligible for a survey under this grant.

The National Fire Plan funding in the Pacific Northwest is intended to support strategic community risk assessment and mitigation plans for fuel reduction. Funding is made available from the Forest Service, National Parks Service, Fish and Wildlife Service, Bureau of Land Management, and Bureau of Indian Affairs as a part of the Wildland Urban Interface Fuels program to implement projects on non-federal lands for reducing hazardous fuels that may threaten communities and natural landscapes within the Wildland Urban Interface.

As the forestry coordinator for this project, Forest Restoration Partnership has been tasked with modeling how a fire would behave in the event that a wildfire does enter our community. In order to accurately model fire behavior, we need to gather data that will help us describe the vegetation in the forest immediately surrounding your home. Unfortunately, forests and wildfires do not know property boundaries, which is why we need the cooperation of as many landowners as possible in order to generate accurate data that can be projected across the landscape.

The survey itself will be very unobtrusive, and of little burden to you, the landowner. It will simply involve establishing a couple temporary measurement plots on each property, marked by a small (3"x3") survey flag, where one of our technicians will record tree heights, diameters, and information regarding overall forest structure.

Please take the time to complete and return the questionnaire included with this letter, indicating whether or not you will grant Forest Restoration Partnership access to your property for the purpose of this inventory.

Again, thank you for your time, and we greatly appreciate your cooperation and support in the development of this community fire plan.

Sincerely,

*Dan Campbell*

Dan Campbell  
Fire Chief  
Corvallis Fire Department

## Attachment 2

*Questionnaire*

Name:

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Tax lot Number:

---

Property Address:

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Do you grant Forest Restoration Partnership permission to access your property for the purpose of conducting an inventory of forest vegetation?

**YES**

**NO**

If you answered “yes” above, please indicate how you would like to be notified of when your property will be visited:

Please call me.

Phone number: \_\_\_\_\_

Please e-mail me.

E-mail address: \_\_\_\_\_

Please knock on the door.

No need to notify.

Thanks,

Forest Restoration Partnership  
(541) 929-4377

## Attachment 3

### *Stand Typing Guidelines*

*Prepared by Jason Dorn, Forest Restoration Partnership*

The stand type descriptions used for this project are based on traditional stand-typing guidelines, as described in John Bell and J.R. Dillworth's manual titled *Log Scaling and Timber Cruising*, pages 311-316, with slight changes made to accommodate data entry constraints of modern software programs such as ArcView. Each code is composed of up to four components, which are used to describe timber types based on predominant species composition, size class of this species, stocking density, and secondary species.

The general format of the codes used is as follows:

#### **D3Mm**

Species, or groups of species for which the timber type has been named are indicated by a capital letter, in this case “**D**,” for Douglas-fir. The number that follows indicates the size class of the dominant species. In this case a value of “**3**” is used to indicate that it is a stand of small sawtimber. The capital letter “**M**” that follows then indicates the stand density, in this case it is a medium density stand. The final letter, or letters, in some cases, is used to indicate the presence of an additional stand component. This letter is always shown in lower case, when it is present. In this case, the letter “**m**” is used to indicate a minor component of bigleaf maple in the stand. This letter code is not used unless the secondary specie(s) compose at least 20% of the basal area of a stand.

*Symbols used to create our stand type codes:*

#### **Timber Types**

**D = Douglas-fir**

**HD = mixed hardwoods**

**O = open** (no existing cover, or inconsistent, patchy cover)

#### **Size Classes**

**2 = pole-sized timber** (5-11 inches DBH)

**3 = small sawtimber** (11-21 inches DBH, mainly younger trees)

#### **Density, or Stocking Levels**

**L = low** (10-39% of site potential)

**M = medium** (40-69% of site potential)

**H = high** (70-100% of site potential)

#### **Secondary Species**

**m = bigleaf maple**

**oo = Oregon white oak**

**d = Douglas-fir**

**c = Western red cedar**

#### **Site Name Code Translation:**

Unique names have been assigned to each stand inventoried, even where the stand type is not unique. The stand name is made up of a pair of two-digit codes, and will appear as follows:

**0301**

The first two digits represent the corresponding forest cover type for the stand. In this case the numerical code “03” indicates a **D3H** stand type. The second pair of digits are consecutive numbers used to identify different stands within a give type. In this case the numerical code “01” is used to show that this is the first stand having that particular cover type. If there were three additional stands with the same cover type, their corresponding name codes would be as follows: 0302, 0303, and 0304.

**Stand Type Numerical Codes**

**00 = O**

**01 = D2H**

**02 = D2Hm**

**03 = D3H**

**04 = D3Lm**

**05 = D3Loo**

**06 = D3M**

**07 = D3Mmoo**

**08 = D3Moo**

**09 = HD2Hd**

**10 = HD2M**

**11 = D2Lc**

**12 = HD2H**

**13 = D2L**

**14 = D2M**

**15 = D3Lmoo**

## Attachment 4

### NFP – WESTERN OREGON GRANT PROJECT Mary's River Estates and Vineyard Mountain Subdivisions Fuels Inventory Protocol

*Prepared by Jason Dorn, Forest Restoration Partnership*

#### **INTRODUCTION:**

This inventory is being conducted in order to model fire behavior in the event that a wildfire enters either one of these communities. Inventory data will be used to generate outputs from the Fire and Fuels Extension of the USDA's Forest Vegetation Simulator software, which will then be entered in FlamMap, which predicts fire behavior at the landscape scale.

#### **SAMPLE DESIGN:**

Sample points will be installed over the entire area of both subdivisions, on a 3-chain-by-5-chain grid, oriented to the cardinal directions. Sample points on the north-south lines are spaced at the 3-chain intervals, and these lines are on 5-chain intervals. This will provide us with a sampling frequency of 1 plot to every 1.5 acres.

Each sample point will consist of a variable-radius plot, and a nested fixed-radius plot. Basal area factor for the variable radius plot will be chosen on a per-plot basis, allowing the technician to keep his/her tree count as low as possible (minimum six trees per plot average). The fixed-radius plot will be a 1/100<sup>th</sup> acre plot (11.8ft), and will be used to measure saplings and pole-sized trees not recorded on the variable-radius plot. Plots established in non-forested cover types will be for the purpose of making fuel model calls only – no tree data will be collected on these plots. If a plot lands on a driveway, road, or within a structure, it will be offset in ½-chain increments, in the direction of travel, until it lands in a suitable location.

#### ***Variable-radius Plots***

- The variable-radius plot will be used to measure all trees greater than 5.5 inches DBH, even if smaller trees are counted as “in” with the selected BAF
- Tree status, species, DBH, base-to-live crown, and crown class will be entered for each live tree recorded on the variable-radius plot
- Heights will be recorded on a frequency of one per plot, with the goal being to have ample heights for all species occurring on the inventory
- Base-to-live crown will be measured for height-sampled trees, and estimated for all others
- Tree status, species (guess if indeterminable), DBH, and height will be estimated for all snags on the variable-radius plot

#### ***Fixed-radius Plots***

- The 1/100<sup>th</sup> acre (11.8ft) fixed-radius plot will be used to measure trees greater than 5 feet in height, and up to 5.49 inches DBH.
- Trees greater than 5.5 inches DBH that fall within this plot, but were not counted as “in” trees on the variable radius plot will be ignored

- Tree status, species, DBH, base-to-live crown, height, and crown class will be entered for each tree or group of trees recorded on the fixed-radius plot
- The first tree occurring on the fixed plot will be recorded as an individual tree, and will have a measured height and base-to-live crown, additional trees will be tallied in groups based on species and 1-inch DBH classes, and will have an average, estimated height recorded for the group.

#### **DATA COLLECTION PROCEDURES:**

This inventory will be conducted using the “NFP\_WO” application in Data Plus Professional, which will be loaded in your handheld data recorder. You will create/use one of two files for this inventory; a file titled “MR\_EST,” or one titled “VIN\_MTN,” depending on where you are conducting the inventory. This application contains two levels of data only – the plot (parent) level, and the tree (child) level.

##### ***Plot-Level Data (Plot\_data)***

- PLOT\_NO: enter the plot number indicated on the map you are using. This entry must be unique.
- BAF: choose a basal area factor for the plot that will allow you to have at least 6 tree records. Press the F2 key (Ctrl+2 on the Ranger) for a drop-down menu of acceptable basal area factors.
- CVR\_TY: is the plot forested or non-forested? Enter a value of “1” for forested plots, and “2” for non-forested plots. (menu available by pressing F2/Ctrl+2).
- FUEL\_M: using the pictorial guide provided, select the appropriate fuel model for the area you are currently in. Look no further than 100 feet (roughly half the distance between plots), or to the next break in vegetation, when determining the appropriate fuel model to enter. Enter the three-digit numerical fuel model code (menu available by pressing F2/Ctrl+2).
- If you are in a non-forested plot (CVR\_TY entry = 2), press Ctrl+down to advance to the next plot.
- If you are in a forested plot (CVR\_TY entry = 1), press the F5 (Ctrl+5 on the Ranger) key to drop into the tree-level data.

##### ***Tree-Level Data (Tree\_data)***

- TREE\_NO: Tree numbers will automatically be entered by the application. This column is formatted as “view only,” and can not be changed by the user.
- TALLY: this column is used to indicate how many trees a given record represents, and it defaults to a value of “1.” Values greater than 1 should only be used for trees recorded on the fixed-radius plot, having similar characteristics (same species, DBH, etc.).
- STATUS: use this column to indicate whether the tree is living (1), recent mortality (2), or older mortality (3). This column defaults to a value of “1,” indicating a live tree (menu available by pressing F2/Ctrl+2).
- SPP: tree species, by USDA R6 numeric codes. Press F2/Ctrl+2 to open the drop-down menu of all available tree species codes.
- DBH: enter the diameter at breast height to the nearest inch.
- HT: when appropriate, enter the height of the tree to the nearest foot.

- HT\_TOP: if the tree being measured has a dead top, enter the height to the top of the live portion of the crown.
- BLC: enter the height from the base of the tree to the bottom of the live crown, to the nearest foot.
- CRN\_CL: enter the crown class code (menu available by pressing F2/Ctrl+2)
- At the completion of all tree-level data, press the F4 key (Ctrl+4 on the Ranger) to exit to the plot-level screen. The application will perform an error check at this time, and will indicate any potential errors in data entry.

## TABLES

**Table 1. Available Tree Species Codes**

CODE	SPECIES
17	grand fir
22	noble fir
42	Alaska yellow cedar
81	incense cedar
202	Douglas-fir
231	Pacific yew
242	Western redcedar
263	Western hemlock
264	mountain hemlock
312	bigleaf maple
351	red alder
361	Pacific madrone
431	golden chinkapin
492	Pacific dogwood
500	hawthorn
746	quaking aspen
747	black cottonwood
760	bitter cherry
815	Oregon white oak
818	California black oak
920	willow

**Table 2. Crown Class Codes**

CODE	CROWN CLASS
1	open-grown
2	dominant
3	co-dominant
4	intermediate
5	Suppressed

**Table 3. Fuel Model Codes and Definitions**

CODE	MODEL NUMBER	DEFINITION
1	GR4	Moderate Load, Dry Climate Grass
2	SH5	High Load, Dry Climate Shrub
3	TU1	Low Load, Dry Climate Timber-Grass-Shrub
4	TU5	Very High Load, Dry Climate Timber-Shrub
5	TL1	Low Load, Compact Conifer Litter
6	TL3	Moderate Load, Conifer Litter
7	TL4	Small Downed Logs

## Attachment 5

### *Fuel Moisture Scenarios and Weather Station Catalog* *Prepared by Jason Dorn, Forest Restoration Partnership*

Variable/Component Range	Mod	High	Ext
Percentile Range	16-89	90-96	97-100
Fuel Moistures			
1 Hour Fuel Moisture	7.60	5.40	4.10
10 Hour Fuel Moisture	9.10	6.80	5.40
100 Hour Fuel Moisture	15.00	12.30	10.40
Herbaceous Fuel Moisture	100.50	69.90	54.80
Woody Fuel Moisture	126.60	101.70	91.50
20' Wind Speed	3.30	4.90	7.20

3771 Weather Records Used, 3432 Days With Wind (91.01%)

WLSTINV1-Weather Station Inventory for 352547

Station: 352547 Name: VILLAGE CREEK NESDIS: 324A14E2

Type: 4 (RAWS S NFDRS) Create/Mod Date: 05-Dec-2006 Obs Time/Z: 13/PST  
Assoc Man: \_\_\_\_\_ Prev Stn: \_\_\_\_\_ Fcst Zone: 603

State: 41-OR County: 039-Lane Lat/Lon: 44 15 8, 123 28 2  
Obs Agy: 2 (USDI BLM) Unit: EUGENE Mnemonic: EUD FS Reg: 6

Fuel Stk: \_\_\_\_\_ Wdy FM Mea: \_\_\_\_\_  
Site: 3 Elev: 1500 Asp: 3 Ann Prec: 65.00 Season:  
Ltng scale: 1.00 Hum code: 2 Temp code: 1 Pres code: 1  
Wind Spd code: 1 KBDI: 100 One/Ten Fl: N

## Attachment 6

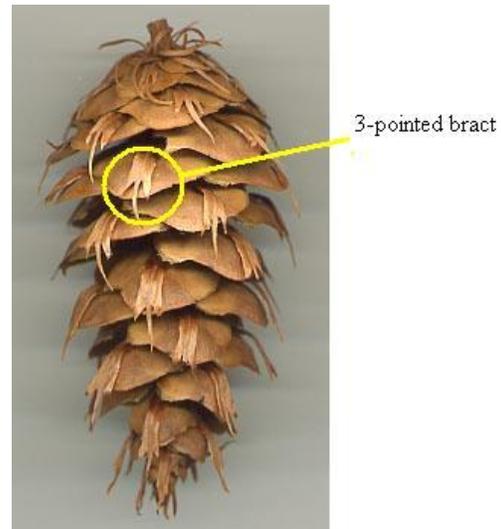
### *Tree Identification*

#### *Douglas-fir*

Douglas-fir is a conifer with flat needles that stick out in all directions around the branch. If the needle is removed from the branch it will leave a small, raised leaf scar. The cones have a very distinct 3-pointed bract, as seen in the picture below.



**Figure 9: Douglas-fir branch**



**Figure 10: Douglas-fir cone**

#### *Grand fir*

Grand fir is a conifer with flat needles that stick out on two sides of the branch. The needles also have a white stomata pattern on the underside, making the bottom of the needle appear white in color.



**Figure 11: Grand fir branch**

*Oregon white oak*

Oregon white oak is a deciduous tree, meaning it drops its leaves in the fall. The leaves are approximately 5 inches long and have 5 to 7 rounded lobes. The acorns are about 1 inch long with a shallow cup.



**Figure 12: Oregon white oak leaf and acorn**

*Bigleaf maple*

Bigleaf maple is a deciduous tree with leaves up to 12 inches in diameter. The leaves have 5 deeply cut lobes and turn yellow-brown in the fall. The seed is paired and looks similar to a set of wings, as seen in the picture below.



**Figure 13: Bigleaf maple leaf and seed**

*Pacific madrone*

Pacific madrone is an evergreen tree. The leaves are leathery and range from 3 to 6 inches long. The most distinct feature is the bark, which is reddish-brown and peels into thin, irregular sections, revealing a greenish-brown inner bark.



**Figure 14: Pacific madrone**