Fuels Management Plan for Moore Park

Prepared for the

City of Klamath Falls, Oregon

Department of Parks and Cemeteries

Valerie Lantz, Director

Prepared by Gene Rogers

Wildland Fire Technologies, Inc.

Klamath Falls, OR

June 2005

Approved by the

Klamath Falls City Council

October 17, 2005

Table of Contents

Executive Summary

This document is a proposed fuels management plan for Moore Park in Klamath Falls, Oregon. Moore Park is a unique city park in that it is forested. The notable dominant tree species is Ponderosa pine. The pine and associated vegetation have evolved in the absence of natural fire through most of the last century. This situation has led to high stem density in trees and shrubs, with a corresponding build-up of flammable woody litter fuels. Moore Park is a dynamic community of vegetation and wildlife. The dynamic of fire has been removed by human decision for close to a century. This plan proposes to offer methodology to return the vegetative community to a condition more like it was before the turn of the century.

The park has been threatened by several wildfires, most recently by the 2003 KAGO Fire. This particular fire made a significant run at the park and actually entered the park, generating spot fires near park structures. This event generated a renewed interest in taking some proactive measures to minimize future threats to the park resources.

The author was requested by the Parks Director, Valerie Lantz to prepare a fuels management plan for Moore Park. In the development of this plan a Forest Resource Management Plan was initiated by Anne Maloney of the Oregon Department of Forestry (ODF). This fuels plan is intended to be a chapter in the Forest Resource Management Plan, and as a stand alone planning document. The author and Anne Maloney have coordinated their efforts throughout this process. They identified vegetative type islands within the park to facilitate discussion and planning.

Funding for cooperative work was made available in 2004 via a National Fire Plan grant received by the local ODF District. This funding generated an opportunity to implement some treatments prior to completion of the plan. As a result 20 acres were treated with fuels reduction activities allowing the public and park managers the opportunity to evaluate such treatments. Additionally, this activity strengthened the working relationship of city, state and federal fire agency personnel.

This plan proposes to treat 116 to 142 acres over the decade of 2004 to 2113. Through a series of treatments by physical labor and mechanized equipment the author proposes to reduce the fire behavior characteristics or fire intensity level across the park. Priorities have been assigned to the vegetative type islands to maximize the effect of treatments.

Completion and acceptance of this plan will set the stage for pursuit of alternative funding sources, such as grants. Past and current cooperative efforts by local agencies have applied National Fire Plan funds to treatments in Moore Park. It is intended that this plan will facilitate future treatments and reduction of fire behavior potential in the park for years to come beyond the one decade scope of the document.

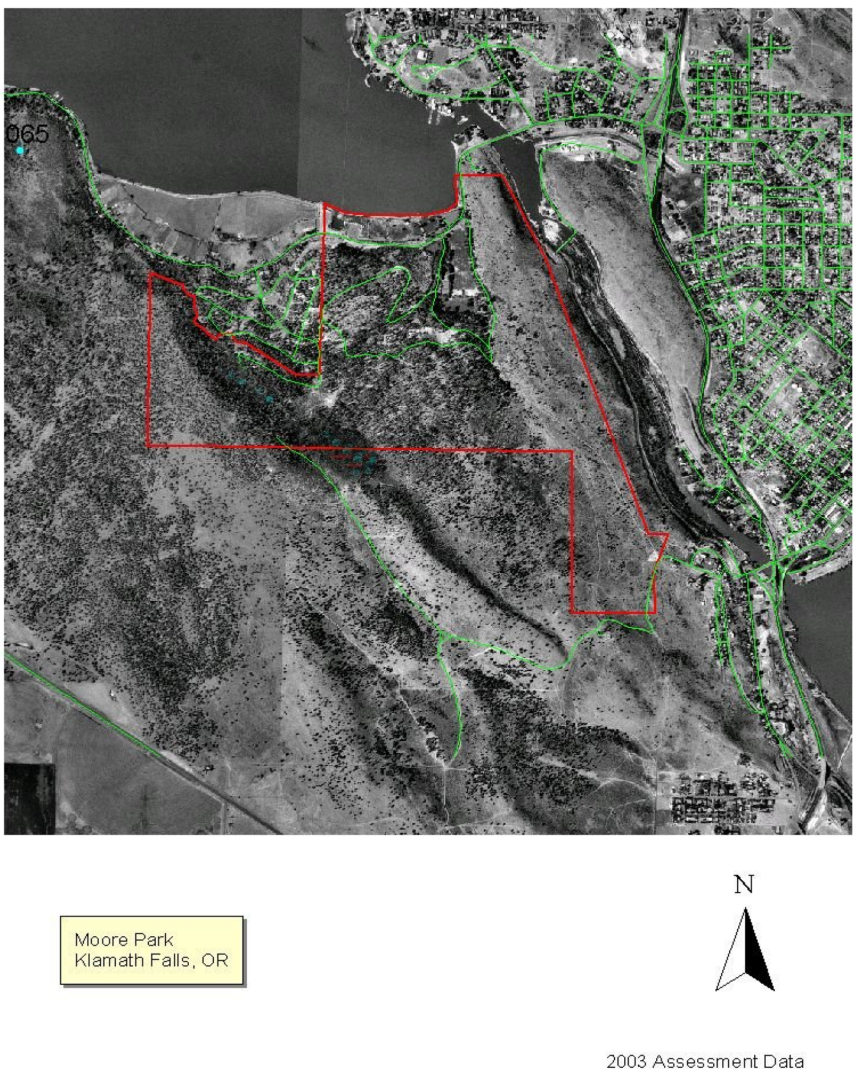
Moore Park Description

Moore Park is located in the city of Klamath Falls, in south-central Oregon. The park is administrated by the Director of the Parks and Cemeteries Department of the City of Klamath Falls.

Situated on the southern shore of Klamath Lake, Moore Park contains approximately 540 acres. 90 percent of the park is classified as forestland by the Oregon Department of Forestry. About half of the acres support forest vegetation which is predominated by Ponderosa pine, with juniper, shrubs and developed areas on the remaining acres.

Moore Park is a unique city park due to its forested condition. The natural beauty of the site dates into history when the location was frequented by Native American people from what is now Oregon and California. Moore Park was a Native American trading village site historically known as Eulalona.

Currently, Moore Park flanks a residential subdivision called Lynnewood. A significant travel route, Lakeshore Drive, dissects the park's Northern boundary. The Link River bounds the park to the East, while open land in private ownership is to the south.



Issues, Concerns and Opportunities / Purpose and Need

The KAGO Fire of August 13, 2003

Wildland fire is a natural part of environment in eastern Oregon. However, unwanted wildfire is an annual threat to Moore Park. This situation has been recognized in past years and brought into more direct focus following the 2003 KAGO Fire. This plan is a direct result of that fire and renewed interest in proactive management techniques.

The KAGO Fire of 2003 burned approximately 217 acres over a three hour period. This human-caused fire, originating in the Riverside Neighborhood, made a late afternoon run into Moore Park and threatened the adjacent residential subdivision of Lynnewood. Following the fire, management personnel from Moore Park made contact with the nearby U.S. Forest Service office at the Klamath Ranger District. Through that contact with fire management personnel the author was contacted. He had been involved in a previous attempt to develop a fuels management plan for Moore Park in the late 1980's. The author met with the City Forester, the Operations Chief from Klamath County Fire District #1 and the fire duty officer from the Klamath Ranger District while the KAGO Fire was still in mop-up operations. A meeting was arranged with the Parks Director, the City Forester and the author. The need to develop a plan was identified in that meeting.

Other attempts to reduce the fire behavior potential in Moore Park have fallen short. Most recently some dead trees were removed from the park in 1995 in an attempt to reduce fire potential. Much of the slash from that operation is still on the ground as surface fuel. No surface or aerial fuel reduction was accomplished in that effort as the project was paid by the selection and removal of live trees which were logged with the dead trees. The additional cost of treating the created slash would have reduced the profit margin and necessitated the cutting of even more trees for revenue. This was a commodity-based project with live trees being taken to market to fund the removal of dead ones. This project is described in the Klamath/Lake Forest Health Management Guide (see references).

As a result of continuing catastrophic wildfire in the United States in recent decades, the United States President signed the Healthy Forest Restoration Act (HFRA) in 2003. The HFRA lead to the creation of the National Fire Plan (NFP) has generated opportunities across the United States to acquire federal funds through grant processes to invest in the otherwise expensive and often cost-prohibitive fuels treatments. The intent of the NFP was to create long-term, cooperative effort among various governmental agency partners. The NFP has made federal funding available to apply to fuels treatment projects. This plan is focused on getting a strategic plan developed in order to pursue funding and cooperative opportunities.

Through the development of this plan the Parks Director has met and developed working relationships with the various cooperating fire agencies in the Klamath Falls area at the city, state and federal level. The Moore Park Fuels Management Plan will become a referenced section in the Klamath Falls Community Wildfire Protection Plan currently being developed. Cooperating agencies in that effort include: Oregon Department of Forestry, Bureau of Land Management, Klamath County Fire District #1 and the City of Klamath Falls.

Fire Behavior Basics

In order to understand wildland fire behavior some known principles need to be introduced and considered before discussing Moore Park specifically.

All wildland fires are the sum product of three components: Fuels, Weather and Topography.

2003 KAGO Fire

The fuels have to be in sufficient quantity, arrangement and of low enough fuel moisture content to ignite.

The weather must be warm and dry enough to support combustion. Wind will assist in moving the fire.

Topography supplies a path or barrier to fire spread.

Fuels

Fuels are described in four categories: grass, brush, timber litter or slash. The size of a fuel particle is important; basically fine fuels (< 1/4" diameter) are responsible for the rate-of-spread of a fire. Larger fuel particles are responsible for the intensity and duration of a fire (twigs, limbs, logs, etc.). Fuel moisture changes daily, even hourly, but a fuel particle only contributes to the combustion process when it is sufficiently dry. Small fuels gain/lose moisture more quickly than large fuels, thus flammability can literally change through any given day.

Fuels may be live or dead. As such, they may be a heat sink or a heat source depending on the moisture content. Live fuels are either annual or perennial grasses or woody shrubs and trees. A live shrub may contribute rapidly to the combustion process when it is decadent, e.g. old enough to have accumulated dead limbs and litter under the shrub. This condition is exacerbated when pine needles have draped into the shrub foliage.

Fuels are arranged on the landscape in both horizontal and vertical patterns. The more continuous the arrangement in either plane or both, the more intensely a fire can burn. Fuels are referred to as ground, surface or aerial. Ground fuels are flammable woody material in the ground: roots, duff and peat. Surface fuels would include forest litter: leaves, needles, twigs, limbs, tree boles, and shrubs. Aerial fuels would be those above the surface fuels: typically the limbs of trees and taller shrubs. When a sufficient pathway from the surface fuels to the aerial fuels exists this pathway is referred to as ladder fuels.

Weather

Weather is a significant factor in fire behavior characteristics. Obviously, weather has to be conducive for a wildland fire to spread across the landscape. Seasonal weather patterns are referred to as climatology. These patterns are often discussed as normal or in terms of deviation from normal. Climatology has much bearing on the vegetation patterns and plant associations on a landscape.

Seasonal patterns and their intensity have direct bearing on fuels. As the weather warms and dries fine fuels, especially the dead fuels begin to dry sufficiently to carry fire. Curing of live fine fuels follows next as the summer season develops. Woody fuels of increasing larger diameter loss moisture through the summer and actually achieve the lowest fuel moisture content in the fall. Deviations from climatology norms can occur, and do, but generally this is the pattern in Moore Park.

Precipitation plays a major role in fire season severity. Duration of moisture input is far more critical than measured amount. For example: 24 hours of cool weather with drizzle for hours measuring ½" of total rain has more effect on fire behavior potential than an 1" storm lasting an hour. Weather drives the rate of moisture gain or loss in forest fuels.

Winter weather and type has a bearing on the intensity of fire season. In general, fire seasons are more severe if a dry, cold snow falls and packs onto forest fuels without a preceding extended period of precipitation as drizzle or rain. The rate of spring thaw can bring "early" fire season conditions to dead fuels. A lack of snow pack or limited snow pack obviously compounds this effect.

Wind is the critical weather element in fire behavior. Wind dictates the direction and speed of fire spread. Shifts in wind directions due to frontal patterns or daily effects (diurnal) make fires move in different directions.

A particularly critical weather factor is atmospheric stability. This is the atmosphere's ability to allow a parcel of air to rise or drop. When a fire is burning under conditions otherwise ideal for fire spread and the atmosphere is or becomes quite unstable a fire behavior referred to as "plume-dominated" may occur. Such fire behavior is responsible for many of the larger, and often infamous, wildfires. Fires under this condition exhibit rapid spread and are characterized by a towering, billowing column.

2002 Skunk Fire on the Winema National Forest (24 miles NE of Moore Park)

The photograph above illustrates the classic, billowing column and cloud formation associated with a wildfire under very unstable atmospheric conditions.

Topography

Topography is the overall shape of the landscape. Topography is typically referred to as slope, aspect and elevation. Although flat ground can produce impressive fire behavior given appropriate fuels and weather, the same fire might be even more dramatic given topographic influences.

Fire will be channeled by terrain features such as canyons. Fires will tend to run upslope faster than they back downslope. Fire may be slowed or literally stopped by topographic features.

Within Moore Park topography is present in a variety of forms. The steep, northern aspect in the west side of the park above the Lynnewood subdivision supports a cooler, more moist plant association than elsewhere in the park.

The topographic influence of the Link River creates a wind corridor from Klamath Lake to Lake Ewauna and the Lower Klamath Basin. This influence can play a role in fire behavior in and around Moore Park.

Fire Behavior Terminology

The following are terms that refer to types of fire behavior.

A smoldering fire is burning in ground and surface fuels, often with little or no visible flame.

A creeping fire is slowly moving, often backing downslope or against a wind. A creeping fire has relatively slow moving flaming front. The flaming front is the zone of active flame at the leading edge of a spreading fire.


smoldering fire


creeping fire

A running fire is moving relatively quickly. Often a running fire is driven by the wind, steep slope (upslope) or a combined influence of slope and wind.

Spotting is when a series of new ignitions are occurring as the result of fire brands landing in receptive fuels beyond the current flaming front.


running fire


spotting

Torching or passive crown fire is a term used when an individual or small cluster of trees exhibit ignition of the canopy foliage.

Crowning or active crown fire is when the canopy foliage of many acres or more ignite.


torching or passive crown fire


crowning or active crown fire

Fire History, Role and Ecology

Moore Park is unique among city-owned and managed parks in Oregon. It is relatively large in size, 540 acres of which approximately 90% is classified as forestland. Of the trees making up the forests, the most notable is Ponderosa pine. This species represents the most popular and remembered forest views within the park. Additional conifers found in the park are Douglas-fir, white fir, incense cedar and Western juniper. A variety of shrubs exist throughout the park and are referenced in the vegetation type discussion.

Being located in the high elevation, dry climate on the eastside of the Cascade mountain range places Moore Park in a climatic zone that has a history of fire. Klamath Falls averaged less than 14” of precipitation per year from 1921 to 2000. The area experiences long, cold winters, hot summers, warm fall weather, with much of the precipitation arriving as snow. Unlike the western forests of Oregon, the eastside forests do not readily reduce dead and down woody debris by bacterial and biological degradation. Put simply, the climate in this area does not have the temperature and moisture regime that is conducive to degradation of woody fuel. When the temperature is warm enough the relative humidity is too low. When the moisture is high enough, the temperature is too low. Needle litter, twig and limb litter and the boles of trees naturally accumulate in this ecosystem.

Fire is the historical agent of change in these dry, fire-dependent forest types. Fire’s historical presence played a role shaping the forestland plant associations. Perhaps more notably the reduced presence of fire has shaped the vegetative condition in the last century.

Relatively frequent, low-intensity fire visited the eastern Oregon Ponderosa pine forests. This type of fire consumed litter accumulated since the last fire. Woody debris: limbs, boles and duff material would be partially to completely consumed by these fires. These fires tended to stay in the surface fuels layer. If the interval between fires increases, a corresponding increase in fire intensity occurs as a result of fuel accumulation. The historical fire return frequency in Oregon’s eastside forestlands ranged from 3 to 25 years and tended to be less severe.

As settlers moved into the west, and specifically to the eastside Oregon forestlands a philosophy that fire was always destructive prevailed. This philosophy was contested most notably by Harold Weaver, a forester with the federal government, in 1943. His premise was that continued fire suppression leads to continued fuel build-up which leads to higher intensity fires that eventually can not be controlled. Ironically, Harold Weaver spent much of his career in the Ponderosa pine forests around the Chiloquin area. He observed and noted the build-up of surface litter fuels and the movement of more trees into sites where fire was excluded.

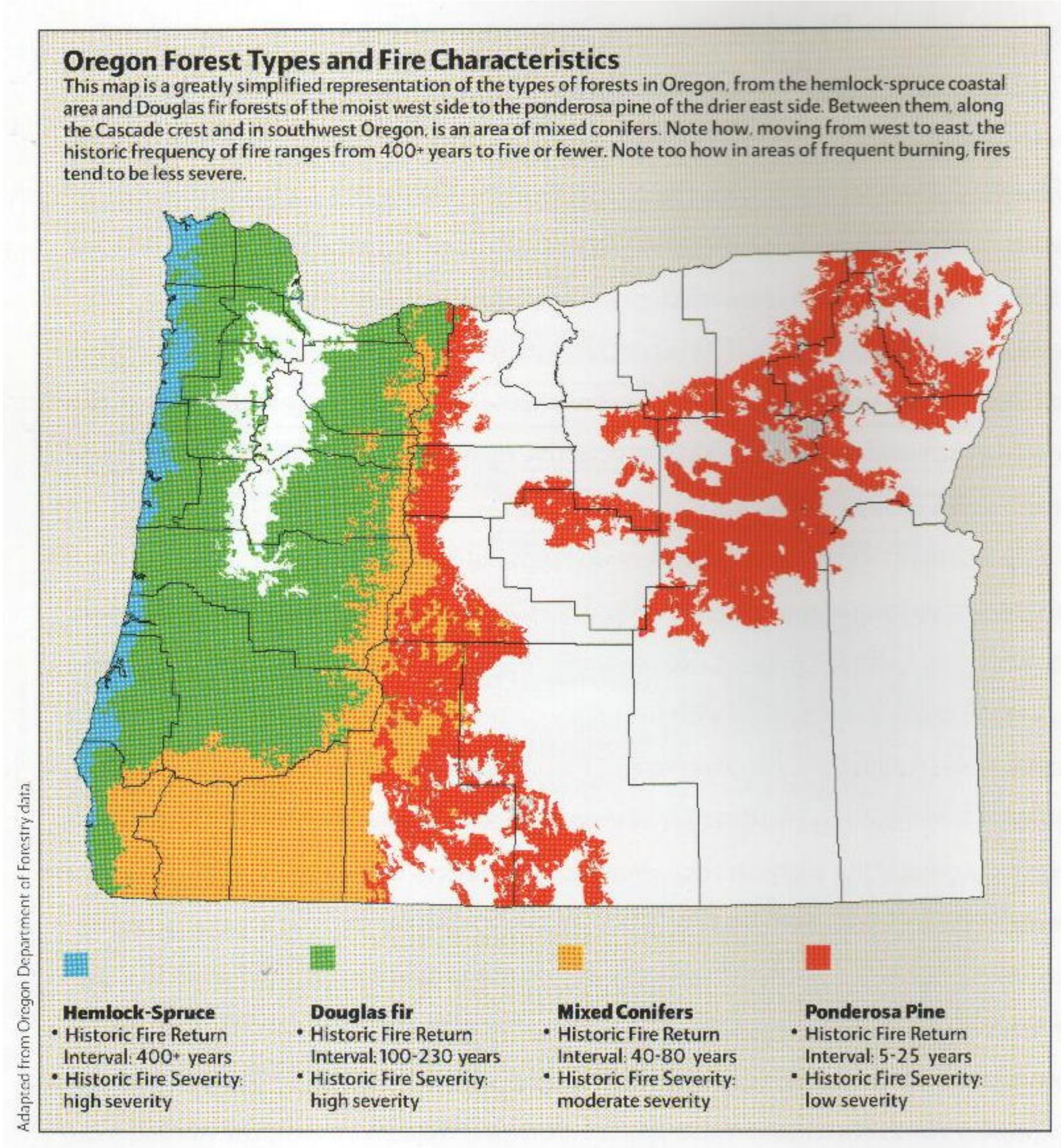


Illustration used with written permission of the Oregon Forest Resources Institute

This illustration from the document: Fire in Oregon's Forests, shows the general range of forest types in Oregon. The forest in Moore Park contains both mixed conifer and Ponderosa pine stands. This condition adds to the unique characteristics of Moore Park which allow a park visitor to observe a variety of vegetative conditions in a short distance within an urban area.

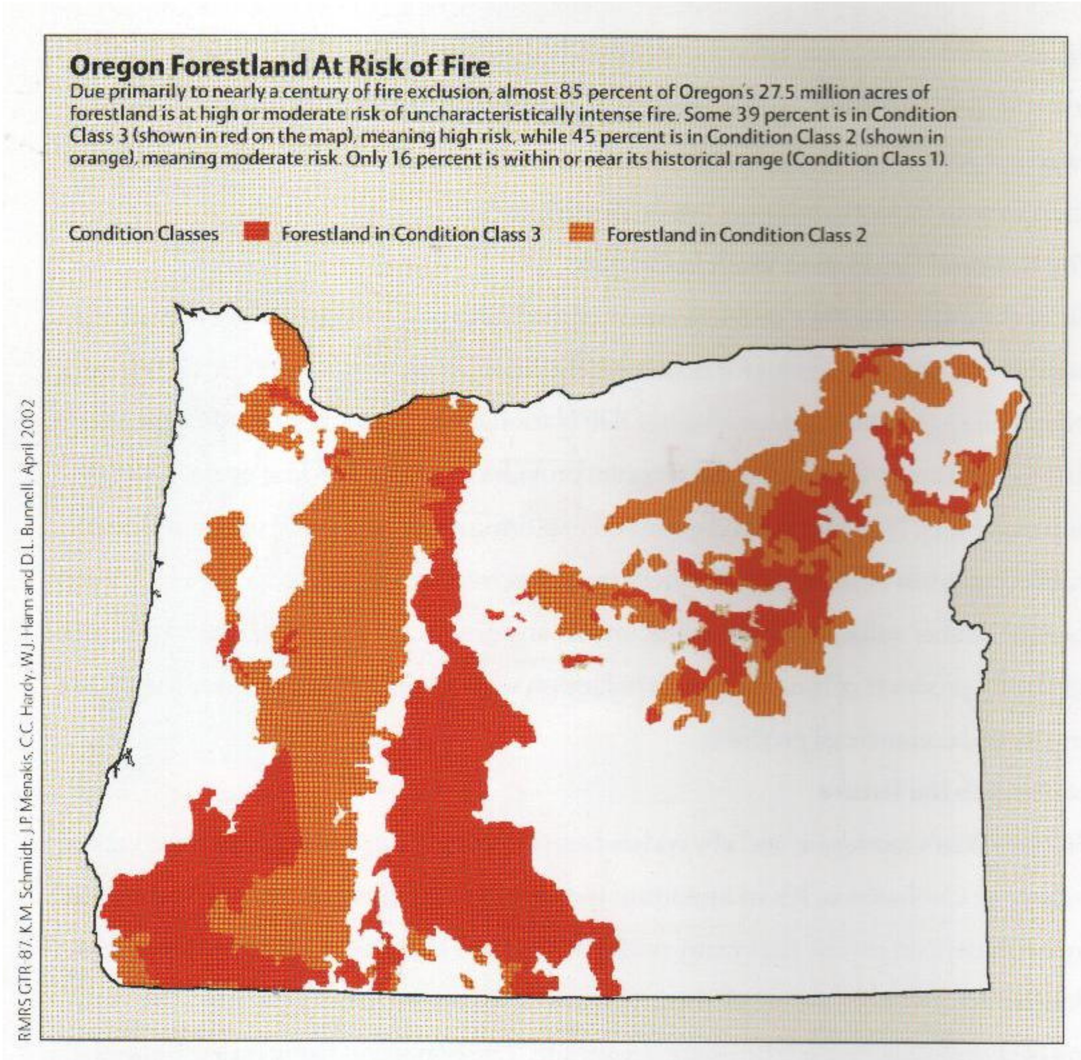


Illustration used with written permission of the Oregon Forest Resources Institute

In the absence of fire, the condition class of the forest shifts away from historical structure. The removal of fire from the ecosystem causes a shift in forest structure to one of higher stocking level (more trees per acre). This increases the presence of ladder fuels, or a physical fuel path leading from the surface fuels to the intermediate aerial fuels of smaller tree limbs to the overstory canopy of the mature trees.

Once a forest has evolved to a more dense stocking level, or Condition Class 2 or 3, the use of fire as a management tool typically needs to follow a thinning to reduce the quantity of surface and aerial fuel before prescribed fire can be used to maintain historical structure.

1905 photo courtesy of the Bureau of Reclamation, Klamath Falls office

2004 photo by Gene Rogers, Wildland Fire Technologies, Inc.

Comparison of these two photographs spanning a century show the changes in forest structure in Moore Park over time.

The density of the mature trees in the 1905 photo should represent a stocking level that evolved through natural processes. The impact of harvesting is unknown. Certainly fire suppression had not played a significant role in shaping the forest to this point in time. Documentation of organized fire suppression accomplishments began on the adjacent Crater Forest Reserve about this same time in history.

The 2004 photo clearly shows the footprint of the KAGO Fire of 2003 in the upper left. Note the same opening was actually larger in the 1905 photo, as was the brush field shown under the cell tower in the center background. These were historical pathways of fire as a result of the combined effects of weather (wind), fuels and topography.

The Ponderosa pine forest has certainly gained density in the 2004 photo. Fire's role has been interrupted over the last century. As the condition class of the Moore Park forest types moves further from historical structure, the more likely a fire could reach intensity levels that would kill much of the mature, overstory trees. The Lynnewood subdivision is behind and to the right of the knob in the right foreground of the 2004 photo. The Riverside Neighborhood is behind the left background. The Southview PUD is located behind the two cell towers.

Fire Spread Scenarios

Local agency records for 2001 to 2003 yield the following statistics. Klamath County 911 averaged 568 calls per year for outdoor smoke reports and brush fires. ODF averaged 61 fires per year, 47% were lightning ignited. USFS averaged 65 fires per year, 67% were lightning ignited. Wildland fire is a reality in the area surrounding Moore Park.

Fire has originated in Moore Park. In fact, there was a small fire in the park during the summer of 2004. In 1982 a fire originated on the ridge above Moore Park and was controlled by local, state and federal resources. Inquiries of fire report records from Klamath Fire District #1 show many fires over the years in the vicinity of the park.

Fire will spread into Moore Park primarily from two directions. The historical path from the south typically involves wind-driven fires moving quickly through the more open grass, brush and juniper covered land outside the park. There are a couple of fire “footprints” as indicated by the brush pockets in the historical and present photos shown on page 15. This path was used by the KAGO Fire of 2003, and the Orindale Fire of 1995. This fire “conduit” will remain as long as fuel is available to carry fire over the terrain.

Fires spreading toward Moore Park from the south have historically been channeled by the terrain and wind. Such fires tend to slow and change burning characteristics when they encounter a ridge or terrain break. At this point the fire will have to begin backing down the slope. Backing fires are slower than head fires as the combined effect of wind and terrain are no longer aligned. A backing fire is less efficient. Such fire behavior was observed when the Orindale Fire of 1995 crested the ridge line on the south boundary of Moore Park over Lynnewood.

The other probable path of fires in Moore Park would be fires running upslope. This would be referred to as a head fire. A fire originating along Lakeshore Drive would move upslope and be pushed in that direction by winds, particularly during afternoon or evening winds off of Klamath Lake. No known recent fires have done this, but the potential exists.

Another fire scar exists to the west of Moore Park. The author understands this is the 1973 Lakeshore Fire. The spread pattern left by this fire indicates a west to northwest wind was pushing it. These winds are associated with cold front passages and are responsible for dramatic fire growth. Such fire growth can fortunately be anticipated, particularly with the state of current fire weather forecasting and monitoring. This represents a third approach for wildfire to enter Moore Park.

Moore Park Vegetation Types

The vegetation types described in this document were defined by the author and Anne Maloney of the Oregon Department of Forestry. They agreed on the need to define areas within the park that contained plant associations that represented a portion of the park. These vegetation "islands" are referred to as Vegetation Types or Type Islands. Although the types are focused on the vegetation, it should be understood that vegetation associations are the cumulative result of climate, elevation, aspect, soils and elements of change: fire, insects, disease and other disturbances.

To define the types it was decided that the author and Anne Maloney would independently survey the vegetation in Moore Park and roughly map these islands on aerial images of the park. The independently defined types were then compared and discussed until a consensus was reached. The vegetative types, numbered 1 through 10, were the result of the collaborative effort.

The Moore Park Fuels Management Plan will be a section of the overall Forest Resource Management Plan (FRMP) for Moore Park. Since the vegetation types will be described and pictured in the master document, the discussion in this section will be specific to fire and fuels information relative to each type. The reader should reference the section entitled Type Island Descriptions in the FRMP document.

Fuel Models

The fuel models referenced in this document are the Fire Behavior Prediction System (FBPS) fuel models developed by Frank Albini in 1976 and further discussed by Hal Anderson in 1982. These fuel models are the national standard for making fire behavior predictions with software such as, BEHAVE, BEHAVE Plus, FARSITE and FLAMMAP. An equation, the Rothermel Spread Equation, underpins these software packages. These fuel models address the surface fuels, not the canopy fuels. The FBPS fuel models are characterized into four categories: grass, brush, timber litter and slash. The various physical descriptors needed for fire behavior calculations are included in the fuel models.

FBPS surface fuel models are classified into four broad groups based on the fuels that are the primary carrier of a fire. Surface fuels can be further classified into “fuel models.” The Fire Behavior Prediction System (FBPS) has 13 fuel models. They are identified in following table. Detailed fuel model descriptions are found in the Appendices.

FBPS Fuel Models

Fuel Group	FBPS Fuel Model
Grass	1 - Short Grass (1 foot)
	2 - Timber (Grass and understory)
	3 - Tall Grass (2.5 feet)
Brush	4 – Chaparral
	5 – Brush
	6 - Dormant Brush
	7 - Southern Rough
Timber Litter	8 - Closed Timber Litter
	9 - Hardwood (pine long needle litter)
	10 - Timber
Slash	11 - Light Slash
	12 - Medium Slash
	13 - Heavy Slash

Environmental parameters, e.g. temperature, relative humidity, wind and topography, are combined with a selected fuel model for making fire behavior predictive runs with software. Fire behavior outputs include: rate of spread, flame length, and outputs for intensity and heat output.

Individuals with appropriate training and prerequisite experience may become a qualified Fire Behavior Analyst (FBAN) as certified by the National Wildfire Coordination Group (NWCG). The author is a current Fire Behavior Analyst and has been qualified since 1987.

All discussions of fire behavior in the Type descriptions assume summer weather conditions conducive to fire spread.

Moore Park Vegetation Types

- Type Island 1 - 61.180 acres
- Type Island 2 - 57.536 acres
- Type Island 3 - 0.961 acres
- Type Island 4 - 66.748 acres
- Type Island 5 - 183.258 acres
- Type Island 6 - 64.088 acres
- Type Island 7 - 58.134 acres
- Type Island 8 - 6.074 acres
- Type Island 9 - 13.207 acres
- Type Island 10 - 29.105 acres

1000 0 1000 2000 3000 4000 Feet

Township 38 South, Range 8 East, Sections 25 and 36
and
Township 38 South, Range 9 East, Sections 30, 31 and 32
Willamette Meridian, Klamath County, Oregon

N

Fuels and Fire Behavior Assessment by Vegetation Type Island

Type 1

This type island is a mix of grass, brush and trees. The predominant fuel model is 2. This grass fuel model will produce rapid rate of spread once the grasses have cured for the season, as in the picture below. Where brush is thick enough to readily carry the fire, fuel model 6 would be appropriate.

Much of this type island is on a west aspect, which would provide an opportunity for fires to move upslope into the park property from adjacent private land. A fire moving up the slope would encounter the ridge that defines the boundary with Type 2 to the northeast. The Southview and Pine Valley PUD plans in the vicinity of this part of the park may add emphasis to some fuels treatments in the future. Human-caused ignition frequency would need to be monitored as increased human activity in the area is expected due to adjacent planned residential development to the south and west. This type island is listed as priority 2. Any work done to reduce decadent brush and ladder fuels in this type island should follow priority 1 areas.

Type 1

Type 2

This type island contains grass, brush and timber. Due to a northeast aspect this area has a relatively cool and moist microclimate. Surface fuel models range from 2 (grass), to 9 (timber litter), with some pockets of decadent brush which is a fuel model 6.

The fire behavior potentials for this area would be relative to the location of the fire origin. A fire originating at the base of the slope would exhibit upslope runs due to the steep slopes. The intensity and rate of spread in those runs would be increased by northerly winds. The possibility of such a fire exists due to the proximity of the Lynnewood subdivision.

A fire coming toward this zone from the south would exhibit a different fire behavior. The flaming front would hesitate along the ridge break before beginning to back down the slope. Spot fires would form downslope under stronger winds. Other than short duration upslope runs, the fire would tend to back down the slope. Fires work their way down such steeper slopes as rolling material such as cones, limbs and stems move down hill. Although old roads exist on the slope in this area, the ability to use them as a fire line is limited, particularly to the northwest on the steeper slopes.

Because fire will either be moving away from the values at risk, or moving toward them in a backing mode down the slope, this area is rated Priority 2.

A fuel break is being placed along the edge between this area and the Lynnewood subdivision. The Oregon Department of Forestry is completing that work during the summer of 2005. A 200 foot wide removal of most decadent brush, some thinning and pruning will leave a buffer less prone to high intensity fire. This will establish a tactical opportunity for any future fire suppression operations.


Type 2


Type 2

Type 3

This is the "Naturescape" in Moore Park.   This area was developed by a citizen's group that planted a variety of tree species. The predominant fuel that would carry fire in this type is grass, fuel model 1. No priority is assigned to fuels treatment in this vegetation type island. This area is mostly open and doesn't significantly contribute to the fire behavior potential in Moore Park. Continued treatments in Type 6 will further isolate this one acre parcel.

Type 4

About 12 acres of the east edge of this type was involved in the 2003 KAGO Fire. This area has a combination of the grass fuel models 1, 2, brush fuel model 6 and some timber litter fuel model 9 under Ponderosa pine stands. Juniper encroachment over the last century has created a ladder fuel problem.

This type is rated priority 1 as it is a direct conduit for fire spread to the highest values at risk in the park. One of the historic pathways for wildfire into the Moore Park area has been through this area. A mosaic of treatments is proposed to generate more variety in age class in the brush component.

By breaking up the continuity in this type, the fire behavior characteristics can be greatly reduced. Young pockets of brush will grow in following treatment. These younger patches will be relatively fire resistant for twenty years or more. Maintenance treatments of underburning would greatly reduce the fine fuel loading and diminish fire spread potential.

During the KAGO Fire in 2003 this type supported fire spread by spotting. That is, embers were carried downwind and found receptive fuel beds for ignition under the decadent brush patches and junipers. This pattern was evident in the burn pattern after the fire and can still be seen today.

Type 4

Type 4, KAGO Fire in foreground

Type 5

This type island is populated by grass, brush and scattered junipers. The predominant fuel model is 2. There are pockets of decadent brush containing sagebrush, rabbitbrush and bitterbrush which would be fuel model 6 due to the accumulation of dead woody fuel.

This area is a large portion of the park, but is given priority 3 as it does not offer a direct conduit for fire spread into the higher values within the park. A private residential structure exists just off the north end of this type. Fuels reduction work to reduce threat to that structure may be in the best interest of the property owner and the responsible fire protection agency for that property.

The east flank of the KAGO Fire in 2003 was established within this type. The existing trail/road system through this area should be maintained to access when the next wildfire approaches the park from the south.

Heavily used by deer, there may be opportunity to improve the vigor and palatability of the browse species and reduce fire behavior potentials at the same time.


Type 5


Type 5

Type 6

This type island is the forested area within the core the Moore Park. The aesthetic appeal of this area is the many acres of open, old-growth Ponderosa pine stands. The grass is best represented by fuel model 2. Timber litter under the Ponderosa pine stands is a fuel model 9, although lack of fire has resulted in a condensed mat of duff and litter with grass over it. Some of the more dense pockets of brush would be a fuel model 6.

The pine stands in this type island represent the highest natural resource value at risk. These stands are at risk from wildfire, particularly where brush and juniper encroachment allows enough understory fuel to put the overstory trees at risk. Additionally, the park structural facilities are in this type. Decadent brush pockets are near the maintenance shop facility.

This type is given a priority 1 for fuels treatments due to the natural and constructed values at risk. Fuels treatment in this type will ensure retention of the old-growth character and a healthy understory component of young, vigorous growth. There may be some opportunity to plant Ponderosa pine seedlings in openings, but this should be done only if natural seedling establishment doesn't follow underburns.

The old-growth trees are at risk to wildfire in much of this type due to increased stocking density and understory vegetation. Juniper has grown into the canopy of many of the pine. Such a condition creates a ready ladder for fire to climb into the canopy of the dominant Ponderosa pine. Treatments to more closely emulate the natural fire regime will be recommended. Fire played a role in generating the stand condition in this forest type, and it should play a role in maintaining the forest type into the future.

Type 6

Type 6

Type 7

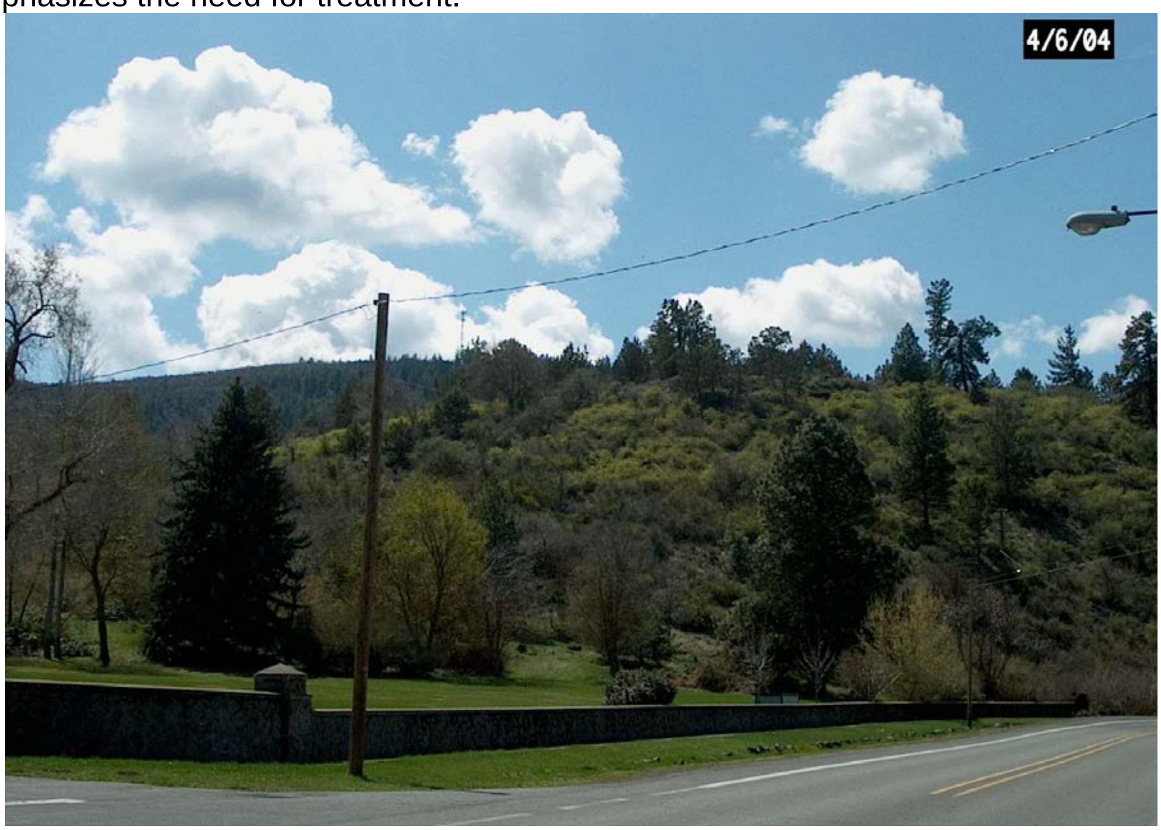
This type is the most intensely managed and utilized portion of Moore Park. It is characterized by irrigated turf and lawns, ornamental trees and parking lots. No fuels treatments are proposed.

Type 8

This area is the brushy hillside above Lakeshore Drive just west of the lawns. Fuels reduction treatments along Lakeshore Drive in the summer of 2004 removed some of the decadent brush. This treatment stopped where the brush meets the northwest corner of the lawns on the south side of Lakeshore Drive.

The brush community in this type island is quite dense and capable of supporting a strong upslope fire spread. This type is given a priority 2. Fuel models 2 and 6 are most predominant. The area treated in 2004 will be a fuel model 5 for many years, which is less flammable than a fuel model 6 due to less woody material.

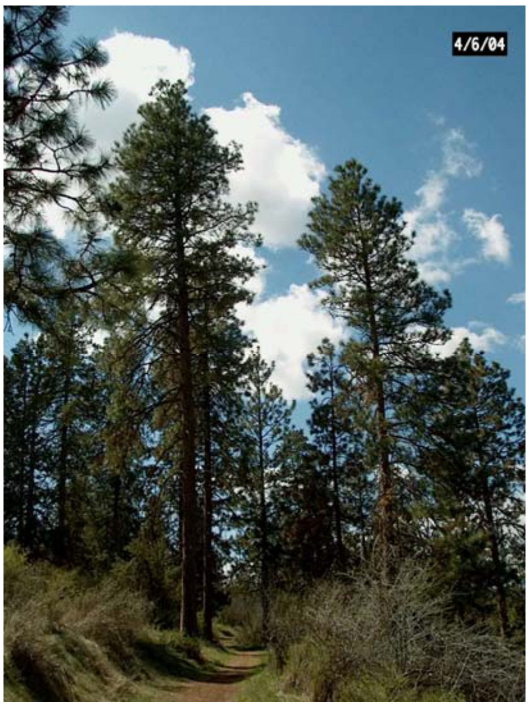
Treatments in this type island would reduce the fire spread potential to adjacent types 9 and 10 to the west. As this type island abuts a lawn area, a high frequency of human activity occurs at the toe of the slope. This exposure to possible ignition sources emphasizes the need for treatment.



Type 7 in the foreground, Type 8 in the background

Type 9

This Type contains some of the most dense brush in the park. Fuel models vary including 2 and 9, but 6 is most predominant. Shrub heights exceed 5 feet frequently. Where accumulations of dead wood material exist, this model is capable of significant fire intensity. However, treatments performed in 2004 have isolated the thickest brush which has younger less flammable brush sprouting below it. This type was given a priority 1 for initial treatment. Frequent visitor use of the walking trail brings increased threat of human ignitions.



Type 9

Type 9

Type 10

Type Island 10 contains a variety of fuel models. Ranging from grass fuel model 2, into brush fuel models 5 and 6 (where more decadent), to timber litter fuel model 9. This Type forms much of the West boundary of Moore Park to the Lynnewood subdivision. Thus treatment priorities along this boundary are significant to present opportunities for successful fire protection of the residential values at risk.

Treatment strategies in this type will be to establish defensible zones along the residential boundary and break up the age class of the brush component. Isolated pockets of older, more decadent brush will be maintained for habitat opportunities; while other sites would be treated to produce a more vigorous and palatable browse for large herbivores.

Type 10

Type 10

Type photos by Gene Rogers, Wildland Fire Technologies, Inc.

2004 Fuels Treatment Accomplishments
A Cooperative Example

During the early winter of 2003, the author and Valerie Lantz began the initial planning discussions about the development of a fuels management plan for Moore Park. It was during these talks that Danny Benson of the Oregon Department of Forestry (ODF) mentioned that he had recently secured a National Fire Plan grant. The funds in the grant were available for hazardous fuels reduction work in the residential area near and within Moore Park. He proposed to start work as soon as the snow was gone and access was available.

The availability of these funds to commence work within the park prior to the completion of the plan presented a need to shift priorities for the planning process. The need to determine a work site generated discussion with Anne Maloney of the ODF. Anne proposed that a forest management stewardship plan be developed for Moore Park. This planning would incorporate many of the resource management topics within one document.

After Anne met with the author and Valerie Lantz, she contacted the Oregon Department of Fish and Wildlife (ODFW) regarding work site restrictions due to bald eagle nesting. It was determined that proximity to nesting bald eagles would be a restrictive constraint on locations that work could be done. A nest was active and successful produced 3 fledglings in 2004.

The author proposed treating a small area within Moore Park as an example. A site was located within the upper road loop in the park, but outside the bald eagle restriction zone. A small crew from ODF performed the work with the author's direction and the City's consent.

This site was one of the stops during the Walk in the Park of April 10, 2004. Many private citizens and agency representatives attended this walk and were briefed by the author and Valerie Lantz on the issues and planning efforts being initiated. Public response was favorable to the proposed work.

The author, Valerie Lantz and Danny Benson reached agreement to begin work on the slope above the old ice rink along Lakeshore Drive and adjacent to the Lynnewood subdivision. This area was a secondary priority to the southern boundary of the park (historical fire patterns), but was of concern and outside of the bald eagle restriction area.

A meeting of a local group arranged by Danny Benson introduced the author's proposal to reduce fire potential in the park. A forester from REACH evaluated the potential for marketing any of the material proposed to be removed. He concluded that there wasn't material he could economically move. The author discussed the project site with ODF, U.S. Forest Service (USFS), Bureau of Land Management (BLM) and Klamath County Fire District #1 (KCFD#1) managers. They all agreed to contribute personnel and/or equipment to the project.

On June 22, 2004 a crew of ODF personnel began work on the slope. The material on the lower slope was pulled down the hill and piled, then chipped later with assistance from KCFD#1 fire personnel. Material on the upper slope was hand piled in place for future burning.

The author met with USFS and BLM personnel in the park to discuss work on the boundary of Moore Park and the Lynnewood subdivision. On July 7, 2004 the BLM provided personnel and equipment in the form of their "Bobcat" with a mowing head. The BLM and USFS provided personnel to prune, thin and hand pile material following the machine work. The following pictures are before and after photographs of portion of the work along the subdivision boundary.

This is the same photo point after the Bobcat work was done. Note the fence post in the left of the photo for reference.

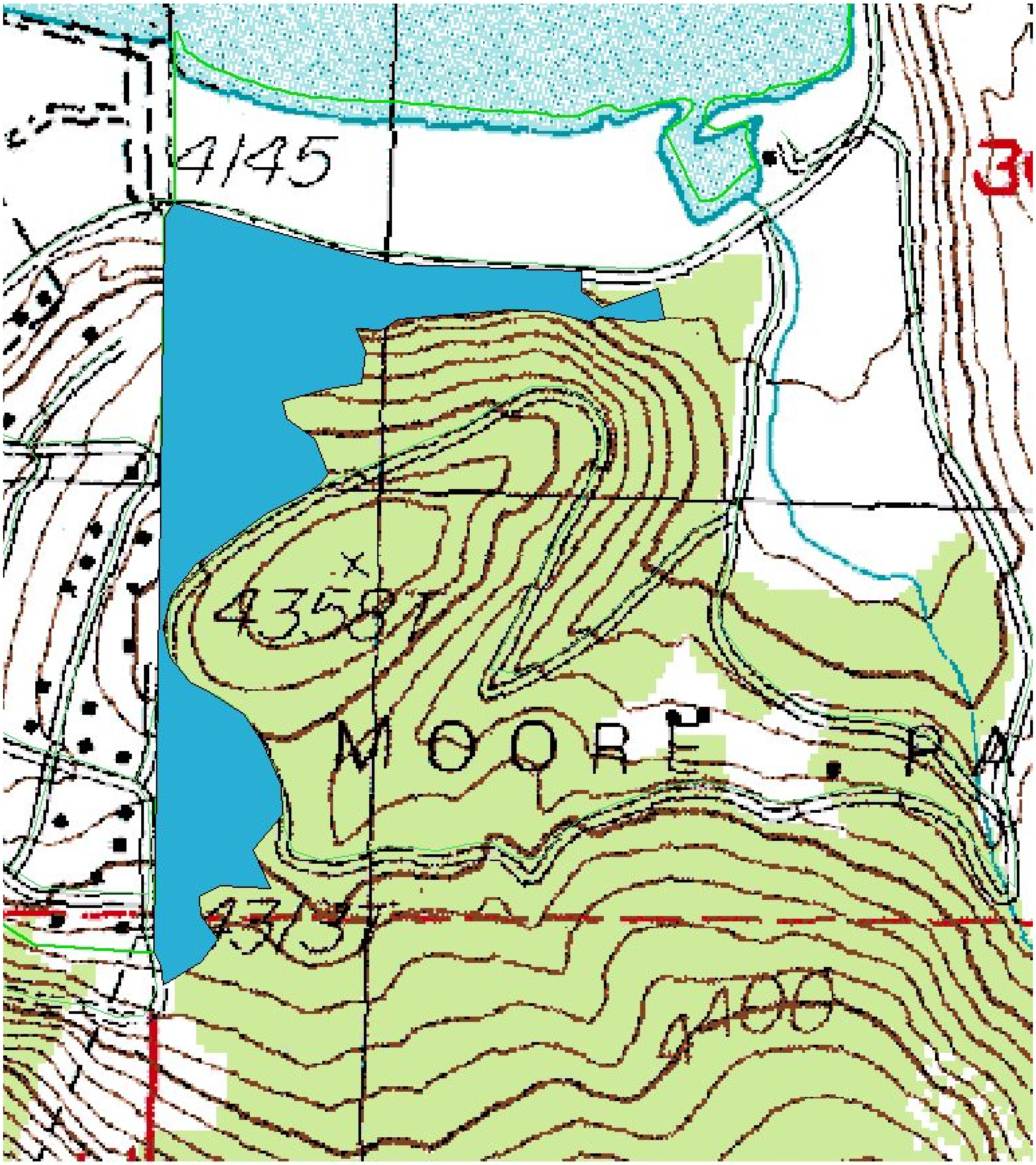
Returning from fire assignments in September, the Winema Hotshots (U.S. Forest Service) completed the face of the slope along Lakeshore Drive with direction from Valerie Lantz. The work involved cutting, dragging and chipping the brush and stems from the slope. By the end of the summer slightly over 20 acres had been treated and hand piles prepared for burning.

Attempts to burn the hand piles in the Fall were thwarted by weather. Ultimately winter weather set in and the atmosphere remained stable leading to a “no burn” decision by the Department of Environmental Quality (DEQ). Meetings with DEQ, the Klamath County Public Health Department, and KCFD #1, USFS (preparing burn plans), Valerie Lantz and the author led to agreement on a process to coordinate the burning when the weather opportunity was arriving. The author confirmed that fuel conditions were favorable for consumption in early March. The cooperating agencies coordinated the plan to ignite the piles.

On March 17, 2005 the piles and a small jackpot area were burned under the supervision of Joy Augustine, Fire Management Officer for the Klamath Ranger District, USFS. Personnel and fire apparatus were provided by an interagency effort including: KCFD#1, USFS, BLM and ODF. All the burning was completed and the smoldering piles mopped-up by dusk of that day. Wet weather arrived the next day punctuating an ideal burning opportunity. Interagency cooperation led to the successful completion of the project. Public comment was favorable and evaluation will continue.




The illustration on the next page shows the treatment area accomplished in 2004.



Moore Park Fuel Treatment 2004
Approximately 20.5 acres

500 0 500 Feet

Proposed Fuels Treatment by Vegetation Type

Vegetation Type	Priority	Acres	Total Treatment Acres	Portion of Type Treated
1	2	62	9	15%
2	2	57	9	16%
3	N/A	1		
4	1	67	32*	48%
5	3	183		
6	1	64	29-37	45-58%
7	N/A	58		
8	3	6	1-4	17-67%
9	1	13	10	77%
10	1	29	21	72%
		540	111-122	21-23%
* includes 12 acres burned in the 2003 KAGO Fire				

Vegetation Treatment Priorities

Priority 1: Locations given this priority represent areas that have values-at-risk, e.g. structures and improvements that are directly or indirectly threatened by wildfire due to the fuels conditions in their vicinity. Natural resource values may also be at risk such as old-growth pine stands. An area may also be given this priority as it may offer a conduit for wildfire to gain momentum and intensity leading to threat to downwind values. These areas will be proposed for the most intense fuels management treatments.

Priority 2: Locations given this priority are represented by areas that have locations where treatment will render some wildfire mitigation, yet the bulk of the area may not lend itself to cost-effective treatment options. Expected fire behavior characteristics in these areas may also offer better opportunities for fire suppression success.

Priority 3: Locations given this priority are areas that are either isolated by location, represent a vegetative condition desirable for retention for wildlife or other resource values, or are external to the interior vegetation types of Moore Park.

Vegetation Types with No Proposed Fuels Management Treatments

Vegetation Type 3

This is the 1 acre parcel in Moore Park known as the “Naturescape”. This area is a small island that contains grass fuels and planted trees and shrubs. It does not pose a fire problem at present as it only contains light fuels. No treatments are proposed. If Park Management decides in the future to manage this site in a similar manner to adjacent vegetation types, then the site could be scheduled for treatments similar to the adjacent type.

Vegetation Type 5

This is the largest vegetation type island in the park. The alignment of topography and winds makes this type island very likely to experience future wildfire events. It is located in the historical “footprint” of fire. This area contains a mix of grass, shrub and juniper, including special status plants. Baker’s globe mallow is found in this vegetation type island, especially within the 2003 KAGO Fire. This plant is listed as imperiled under Global Heritage Status. Some pockets of decadent brush (sage/rabbitbrush) on the ridge line above the Link River. These present an opportunity for mechanical mastication and jackpot burning, but this would have a low priority (3) as a fire objective, perhaps wildlife would benefit from some diversity in age classes. Grass would be the primary carrier of fire in this type island, which would be present in varying quantities every year. A treatment in the shrub component would have the lasting effect of reducing fire intensity for 20 years or more.

Other resource values such as wildlife, soil erosion and cultural resources would need to be considered in any treatment decisions, fuel treatment may generate undesirable disturbance. Pre-suppression planning by fire suppression agencies based on past experiences would help minimize the impacts of the high probability of future wildfire entry in this vegetation type. A fire in this type island would be flanked by the Link River to the east.

Vegetation Type 7

This is the actively managed lawn and landscaped portions of the park that do not pose an opportunity for the spread of a wildfire. No fuels management treatments are proposed for this type.

Vegetation Types with Proposed Fuels Management Treatments

Vegetation Type 1

The Oregon Department of Forestry plans to complete a 200 foot fuel break project where this type island meets the Lynnewood subdivision. This work is scheduled for the summer of 2005. This work will reduce the density of shrubs and some trees. The result will be a zone of reduced fire intensity on about 9 acres in this type island. The remainder of this type island is quite distant from values in the park, thus no further treatment is currently proposed.

This type island is perhaps more valuable for wildlife than for treatment priority. A planned development nearby will likely bring an increased threat of human ignitions. As the development proceeds the threat of human-caused fires needs to be monitored. Mechanical treatment could create a fuel break along the ridge line between this type and type 2. Such a break could slow an approaching fire from below and offer a location to implement fire suppression tactics. Fuels treatment could be considered during the planning process as a condition of development approval.

Vegetation Type 2

Some of the heaviest fuel pockets in Moore Park are in this vegetation type island. However due to aspect this slope is cooler and more moist than all the other types. A fire in this type would either be moving uphill and away from values, or a backing fire dropping off the ridge. A backing fire could be checked along existing roads and ultimately stopped along the boundary of the Lynnewood subdivision.

This type island contains known bald eagle nest trees. This wildlife resource value would need to be considered in any future fuels treatments or fire suppression operations.

Oregon Department of Forestry plans to complete a 200 foot fuel break project where this type island meets the Lynnewood subdivision. This work is scheduled for the summer of 2005. This work will reduce the density of shrubs and some trees. The result will be a zone of reduced fire intensity on about 9 acres.

The steepness of the slope throughout much of this type island makes additional treatment expensive and probably not cost-effective. This site has had recent wildfire encroachment without significant impact, although this fire was a backing fire. A running head fire originating from the lower slope would prove lethal to many of the trees during peak fire season weather. Such a fire would be moving away from the Lynnewood subdivision, although ember shower would remain a threat.

This type island was commercially thinned in the 1995 treatment. Due to the expense of doing hand work on such a steep slope, no further treatment is proposed by this plan.

Vegetation Type 4

This type contains many acres of decadent brush and encroaching juniper. It forms a section of the southern park boundary. The topography and fuels represent a threat to the interior of the park via the historical path of wildfires. Although containing some steeper ground, 25-40%, the bulk of this type would be well suited to mechanical treatment.

A mosaic of mechanical treatments with follow-up jackpot burning (if needed) is proposed. Suggested treatment would include a reduction of brush density, removal of ladder fuels by pruning and removal of encroaching juniper, particular where the juniper is near a pine canopy. A variety of machines would be able to achieve the desired results, including but not limited to the "Slashbuster".

Treatment areas should be selected by an inter-disciplinary team that would consider park management objectives, wildlife, cultural resources and fire. The KAGO Fire of 2003 burned 12 acres in this type, this area should be monitored and photo-documented. It is recommended that fuels treatment applied to an additional 20 acres over two to four years. The option of treating more acres per year may prove more cost-effective for equipment contracting. The results could be monitored and additional treatment evaluated at 10 years. Priority location for initial treatments would be along the southern boundary of the park and adjacent to the steeper slope. Treatment of acres in the vicinity of the KAGO Fire "footprint" would lessen the impact of future fires in this historical fire pathway. These treatments, and all Moore Park treatments, should also be communicated to the fire protection agencies/departments to assist them in pre-suppression planning.

Vegetation Type 6

Contains the bulk of the old-growth Ponderosa pine in the park, thus represents one of the most popular aspects to park visitors. Some of these stands are ready for maintenance underburns now. Small mosaic burns of 1-3 acres are recommended. Such burns could be safely conducted with a small contingency of personnel and completed easily in a few hours. Such smaller burns could be more likely accomplished in light of smoke management issues. Results would include reduction of the surface fire intensity by reducing the litter fuel loading and reduction of shrub and juniper encroachment. Grass would be stimulated by such burns. Planting of Ponderosa pine should be periodically considered to ensure future trees in the canopy. Some thinning and pruning may be needed to prep for the underburns.

Some of the park structures are adjacent to this type. A more intense treatment may be needed to mitigate threat in the immediate vicinity of these structures. Recommend 30 feet of intense thinning, pruning and brush removal adjacent to structures. A less intense treatment could be applied in the area 30 to 100 feet from the structures and beyond. The intent would be to remove the decadent, woody material and create defensible space around the structures. Such an area is immediately upslope of the park maintenance buildings and equipment yard.

Most of the terrain is conducive to mechanical work. It is suggested to reduce brush density, remove of ladder fuels by pruning and remove encroaching juniper, particular where the juniper is near a pine canopy. A variety of machines would be able to achieve the desired results, including but not limited to the “Slashbuster”.

Mechanical treatment areas should be selected by an inter-disciplinary team that would consider park management objectives, wildlife, cultural resources and fire. It is recommend treatment be applied to 20 acres over two years. The results could be monitored and additional treatment evaluated at 10 years. Priority location for initial treatments would be along the southern boundary of the park.

A small patch of jackpot burning was done on 3/17/05 during the burning of the hand piles made in 2004. This patch should be monitored to ensure desired results. The patch of woody debris was created by the “Bobcat” machine used by the BLM when it masticated a clump of brush. The debris was ignited and allowed to burn without the expense of hand piling of the material. This patch is an example of the results that could be achieved by similar treatments.

Vegetation Type 8

This small vegetation type island is 6 acres of decadent, dense brush, scattered juniper and grass. It is isolated by 2004 treatments, lawns to the east and proposed treatment in type 10 above it. No treatment is proposed until treatment above it is completed. The need to treat this island should be evaluated at that time. This area is heavily used by deer and birds and may be recommended for retention by a wildlife biologist. The area is also readily accessible to people, thus human-caused ignitions remain a threat. The heavy grass component at the boundary of the lawns should be trimmed annually prior to curing to reduce the fire hazard.

Vegetation Type 9

The fuels treatments of 2004 covered the lower slope above Lakeshore Drive. This area is a good candidate for an underburn to reduce the surface fuel loading of litter and limbs. Additional treatment of 2 to 3 acres in area “A” is proposed. This work could be done by machine with follow-up jackpot burning as needed. This would leave a patch of denser, old brush for diversity and wildlife habitat. This remaining patch of a few acres would be surrounded by younger shrubs re-growing following the 2004 treatment.

Many old-growth Ponderosa pine are in this type island. The reduction of surface fuel via underburning would further reduce the threat of losing some of these trees to a wildfire. The open stand condition left by the mechanical treatments in 2004 could be maintained with periodic underburns. Park managers should consider the desired future condition for this site. If left alone and fire is excluded, the site will develop a dense, tall brush stand which will return the threat of mortal fire intensity to the remaining trees.

The treatment completed in 2004 on the slope over Lakeshore drive accomplished the primary objective of reducing the quantity of decadent brush on the slope. This greatly reduced the threat to the mature pine from wildfire. However, forest litter fuels that have accumulated over decades are still present. This layer of needles, twigs and limb material would allow a fire on the slope to generate more intensity than if the material was reduced by underburning. A risk of scorch and potential loss of a mature Ponderosa pine or a few is possible with an underburn, but can be minimized. There is a risk of losing many of these trees in a wildfire originating on the base of the slope. Planning and executing an underburn on this slope would maximize the potential for the old growth Ponderosa pine to survive a wildfire.

Vegetation Type 10

Additional treatment in areas “B” and “C” is proposed in 2006 and 2007 respectively. The treatment specifications would be the same as the 7.8 acres treated in this type island in 2004. Thinning of trees should target juniper over pine. The large brush pocket in “B” may be a planting opportunity, although the soil is poor and probably why brush is prevalent. The remainder of this type island can be retained as an opportunity for retention of some of the more advanced age brush. Spot thinning and pruning of pine would further support the survival of the pine in the event of a wildfire.

Proposed Treatments Tables

The next two pages contain tables identifying the proposed treatments by year, type island, treatment type and acreage to be treated. The tables are presented as an tool, not a required schedule. Park managers will need to make annual work plans based on available budgets. It may prove more cost-effective to do more acres of work to lower overall costs for contracted equipment. Move-in and move-out costs would be incurred for multiple entries over successive years, so savings could be realized by treating more acres of mechanical work in a single year.

The abbreviations for treatment type are described in a table and text following the Proposed Treatment Tables. A summary table follows the first two tables.

The treatments in parentheses are treatments that may not be required following another preceding treatment. Evaluation of the need for the second treatment would follow the first treatment. Example: (JB) would be evaluate the need for jackpot burning following a mechanical or ME treatment.

Blocks showing monitor or evaluate are located at the approximate year to do that review work based on the treatment years. These are flexible to the treatment year and are noted as a reminder to do the follow-up review of any work to be sure the combined park management objectives are being met.

The Oregon Department of Forestry is doing fuel break work in vegetation type islands 1, 2 and 6 in the summer of 2005. This work will be done by a hand crew to generate a 200 foot fuel break along the boundary with the Lynnewood subdivision. Additional work in the Fall is proposed by that agency with a contracted "Slashbuster" generating a similar fuel break, where terrain allows, along the southern boundary of Moore Park in type islands 4 and 6. **Completion of a survey and marking of the park boundary will be needed to be sure this work is done on park property.** If this work is completed in 2005, the acres accomplished would be subtracted from the proposed total acres of treatment in type islands 4 and 6 respectively. The goal in these two types would be to reduce the shrub and stem density on approximately ½ of the acres.

The treatment areas referred to as "A", "B" and "C" are labeled on page 44. The area shaded in blue is the portion of the park that was treated in 2004. Treatments proposed in "A", "B" and "C" are designed to complete a series of fuels reduction treatments that should reduce the fire behavior potential in this portion of the park well beyond the decade addressed in this plan.

Proposed Treatment Table 1

Year	Type Island			
	1	2	4	5
1 2004			12 ac. of 67 burned in 2003 KAGO Fire	
2 2005	200 ft. fuel break along Lynnewood boundary HC, PR, HP/PB or CH 9 ac.	200 ft. fuel break along Lynnewood boundary HC, PR, HP/PB or CH 9 ac.	200 ft. fuel break along south boundary ME, (JB)	Consider treatments for wildlife
3 2006			5 ac. ME, (JB) or 10 ac.	
4 2007			5 ac. ME, (JB) or 10 ac.	
5 2008	Evaluate risk from development, consider ridge treatment		5 ac. ME, (JB) Evaluate PL Pine	
6 2009			5 ac. ME, (JB) Evaluate PL Pine	
7 2010				
8 2011			Monitor and evaluate treatments at 5 years	
9 2012				
10 2013	Evaluate risk from development, consider ridge treatment	Monitor fuel break		

Proposed Treatment Table 2

Year	Type Island			
	6	8	9	10
1 2004	3.7 ac. of 64 HC,PR,TH,HP,ME	0.7 ac. of 6 HC,PR,TH,CH	8.3 ac. of 13 HC,ME,PR,TH, HP,CH	7.8 ac. of 29 HC,ME,PR,TH, HP
2 2005	3.7 ac. PB, fuel break along Lynnewood HC, HP/PB 1 ac. and south boundary ME, JB		4 ac. PB, JB of 8.3 prepped in 2004	7.8 ac. PB prepped in 2004
3 2006	10 ac. ME, (JB)		Consider UB in 2- 4 ac. treated in 2004	7 ac. "B" ME, PR, TH, HP, PB, JB
4 2007	10 ac. ME, (JB)			6 ac. "C" HC, CH, PR, TH, HP, PB
5 2008	1-3 ac. TH, PR, UB		2 ac. "A" ME or HC/CH, PR, TH, HP, PB, JB	
6 2009	1-3 ac. TH, PR, UB		Evaluate PL Pine	Evaluate PL Pine
7 2010	1-3 ac. TH, PR, UB Evaluate PL Pine	Consider HC, CH or HP/PB, PR about 3 ac.		
8 2011	1-3 ac. TH, PR, UB			
9 2012	1-3 ac. TH, PR, UB			
10 2013	1-3 ac. TH, PR, UB Monitor brush every five years	Monitor brush every five years	Monitor brush every five years	Monitor brush every five years

Proposed Treatments Summary Table

Year	Total Acres Treated
1 2004	20
2 2005	35*
3 2006	22 - 31
4 2007	21 - 26
5 2008	8 - 10
6 2009	6 - 8
7 2010	1 - 3
8 2011	1 - 3
9 2012	1 - 3
10 2013	1 - 3
Ten Years	116 - 142
* 35 acres includes piles burned in 2005 that were prepped in 2004	

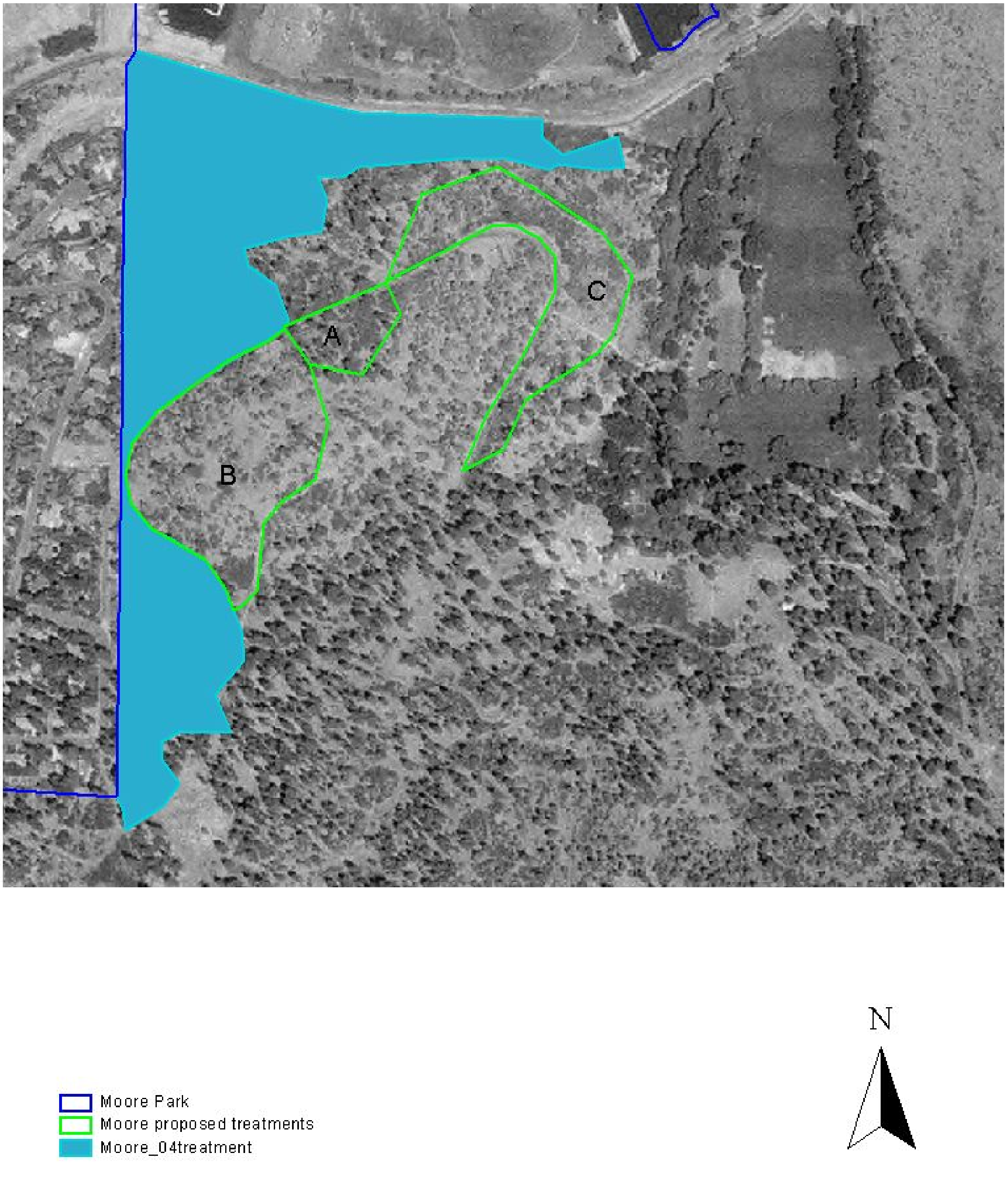
Note: the Total Acres Treated vary from the previous table Moore Park Fuels Treatment by Vegetation Type as some acres may be counted in consecutive years when prep was done in the first year and final treatment completed in another.

Future decades of management in Moore Park would need to continue with the monitoring, evaluation and planning of subsequent fuels management treatments. Actual treatments should be well documented to aid the evaluation phase. Evaluation of past treatments will guide the development of future treatment plans.

Even with some introduction of fire to the park vegetation, the fire regime in Moore Park has been interrupted and the vegetation has responded to that change. The shrub component will continue to be invasive, particularly during seasons such as 2005, where high rainfall quantity is followed by hot summer weather conducive to growth. The treatments proposed in this plan should remain viable until the brush component has become old enough to develop a dead woody component in the shrub and on the ground as litter. This timeframe is expected to be approximately 25 years based on experience with shrub communities in adjacent federal forest.

The availability of National Fire Plan (NFP) funds creates a significant opportunity for local agencies to cooperatively work to accomplish the proposed schedule of fuels treatments in Moore Park. One of the objectives of the NFP is to improve collaborative efforts within communities. The proposed schedule of work could be easily supported by the local agencies with or without NFP funding. The availability of the funds only adds impetus for the fire agencies to support Moore Park. The Director of Parks and Cemeteries does not currently have the staffing or budget to pursue such a program.

Moore Park Fuel Treatments



Proposed Treatment Codes and Descriptions

Treatment Code	Treatment Description
HC	**Hand Cut**: hand labor cutting of brush, typically with chainsaw
PR	**Prune**: removal of dead and live limbs, done with pole saw or chainsaw
TH	**Thin**: reduce the density of trees or shrubs, typically with chainsaw
HP	**Hand Pile**: piling of slash (woody debris), by hand, for future burning
ME	**Mechanical**: use of machinery to reduce small tree and/or brush density
CH	**Chip**: reduction of slash to chips for on-site or off-site use or disposal
PB	**Pile Burn**: use of prescribed fire to remove the piled slash
JB	**Jackpot Burn**: use of prescribed fire to reduce slash in un-piled concentrations
UB	**Underburn**: use of prescribed fire to reduce fuel loadings under forest canopy
PL	**Plant:** to plant trees or shrubs, by hand tool

Hand Cut

This manual labor can be quite expensive per acre compared to mechanical options. However, hand labor is the only option on the steeper slopes (>35%). This method allows for the most selective process for cutting vegetation and allows for a less even appearing treatment.

Prune

Removal of dead and some live limbs on trees. Conifers do not re-sprout so this treatment is durable over time. The benefit of pruning limbs in conifers is to eliminate ladder fuel. By raising the canopy base height the ability for a fire to enter the canopy fuels is greatly diminished. Limbs should be pruned to 12-15 feet on mature trees, or to retention of 70% of the crown on younger trees.

Pruning can also be done in shrubs. In this case the effort is to remove decadent, woody or dead material from the brush. Not a cost-effective treatment over the landscape, but an option where vegetation retention is desired, e.g. near buildings, and visual foreground areas. This technique does not mitigate the litter accumulations found under the brush and other work, such as raking will be needed to adequately reduce fire intensity potential.

Thin

Reduction of the stocking level or density of trees and shrubs, typically done by hand with chainsaws. Thinning can also be accomplished with a variety of mechanical equipment, particularly those with an articulated power head. Slash typically would be hand piled and subsequently burned. Chipping is a good option where there is access to get the equipment to the work site. Smaller trees growing under larger trees would be removed, e.g. encroaching juniper under a Ponderosa pine. Canopy spacing of a minimum of 15 feet is recommended to reduce crown fire potential. If desired trees have canopies closer than 15 feet could be retained in small clumps, particularly if adjacent to area with few trees. Pruning of retained trees greatly reduces the possibility of fire entering the canopy.

Thinning of brush clumps, particularly with a machine, can be cost-effective. Reduction of the density of older brush containing a high ratio of dead limbs and litter is the objective.

Hand Pile

Manual labor of moving limbs, trunks and other woody debris to a pile site and placing it in a pile for future burning. This work is often done when material is freshly cut, then the piles are covered to keep dry until ignition. Material should be placed in a parallel manner to facilitate ignition and minimize the need to push in the material as it burns.

Mechanical

This treatment type runs a wide range of options. A variety attachments for tracked equipment exist for mowing, mulching, and masticating of vegetation. The work in 2004 was done with a Bobcat equipped with a dual mower head. An excavator equipped with a “Slashbuster” head can do several acres an hour under peak production conditions. This process leads to some disturbance of the ground, although impact is minimal as the machines exert very low ground pressure by design. Subsequent treatment would include jackpot burning, or hand piling and burning. If the material is well scattered it could be allowed to remain as distributed during the mastication. The most cost-effective option would be machine mastication with a single entry where debris is scattered enough to not represent an additional fire hazard.

Equipment is limited by terrain conditions such as rock and specifically by slope steepness. Although many types of equipment are rated to perform on slopes up to 45% percent, consultation with many local experts indicates that planning to work on slopes beyond 30% becomes marginal. The slope ranges within Moore Park are illustrated on page 48. The shaded areas would quickly become marginal.

A “Slashbuster” costs about $250 per hour and can treat 3-5 acres per day (based on multi-day, larger acreage projects). The BLM operated “Bobcat” used in 2004 produced about 14 acres in 5 days at about $150 per acre (equipment plus operator).

Chip

The slash generated from thinning and pruning is fed directly through a chipper. Chips should be taken off-site as they do not decay rapidly. Advantage is the material is mitigated in one step following the cutting. Efficiency of the operation is dependent on the distance material must be physically moved to feed it through the chipper.

Pile Burn

The ignition of constructed piles during prescribed weather and fuel moisture conditions. Scheduling can be difficult to achieve due to weather limitations. Fall and Winter atmospheric stability generates smoke management issues with public health. The best conditions would involve light winds to disperse the smoke. Ideal conditions exist at the onset of wet weather in the Fall. Spring weather can be too wet, but often offers opportunities. The March 17, 2005 hand pile burning is a good example of material being dry enough with little or no creep from piles due to green-up of grass. Personnel need to be prepared to respond to opportunities to complete the burning. Requires labor commitment to patrol and tend the piles (push in the material to ensure more complete consumption).

Jackpot Burn

Material burned as it exists following cutting or natural accumulation. Good technique to reduce fuels after a mechanical treatment in brush. Jackpot burning offers a more economical option than hand piling prior to burning. This technique is proposed as a considered follow-up treatment after mechanical mastication.

Underburn

Litter is burned under prescribed conditions, typically strip ignitions, under a canopy. Such burning may involve grass, timber litter and shrubs. This treatment would be most applicable in the Ponderosa pine stands in Moore Park. Treatment can be applied in the Spring before grass green-up, Summer (as conditions allow, e.g. when grass is beginning to cure but still a bit green) or Fall. Fall underburning results in the most consumption of woody material and duff.

The objective of underburning would be to mimic the natural fire regime that existed prior to the introduction of fire suppression. The goal is a low intensity fire that consumes a varying proportion of the accumulated litter fuels and greatly reduces the fire intensity potential of the treated acres for several years. Such burning would become the maintenance treatment for much of Moore Park. This maintenance treatment should be considered in type islands 4, 6, 9 and 10. These type islands total roughly 173 acres. If 3 acres were burned annually, roughly ½ of the acres would be underburned every 30 years. Such a cycle would insure reduced fire intensity in these type islands while allowing natural regeneration of vegetation, including Ponderosa pine seedlings in created openings.

Maintenance underburns represent a limited opportunity for escape as the intensity is easily maintained by the ignition technique coupled with the reduced fuel loadings, particularly once the initial prescribed fire has been applied.

Smoke management will remain the largest issue with any burning in Moore Park. Small underburns could be planned and accomplished when conditions are favorable. The trade-off is periodic, planned small ignitions versus unplanned wildfires that produce large quantities of smoke and threaten values within and adjacent to Moore Park.

Underburning costs vary with project size, but often are under $50 an acre. Doing small mosaic burns in Moore Park will cost significantly more due to less acres over which to apply the costs. The best option for Moore Park is to solicit assistance from local agencies such as the U.S.F.S. and B.L.M. for such burning. These projects would offer an interagency training opportunity for other local agencies and fire departments.

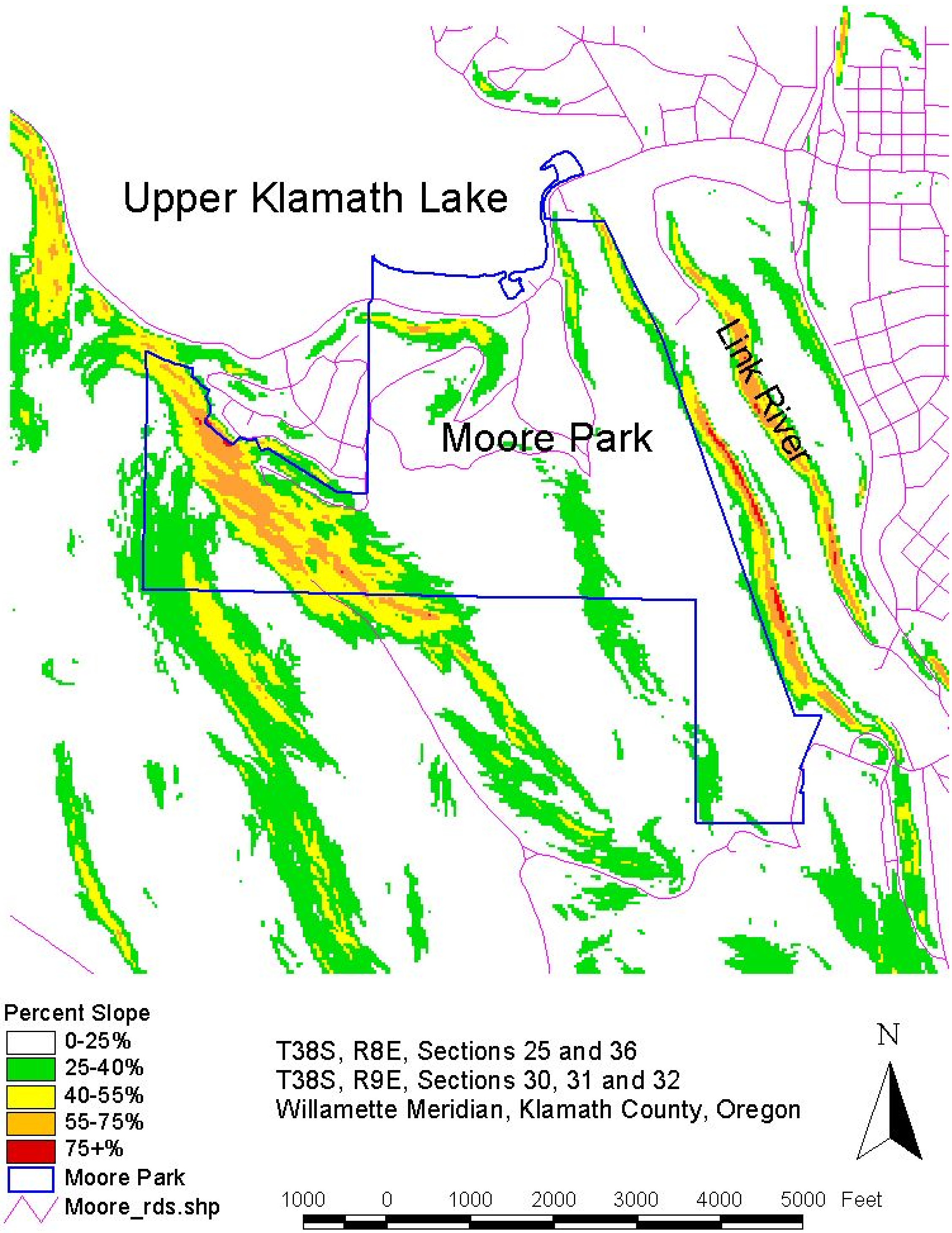
Plant

To physically add grass, seedlings or shrubs to the vegetative mix on a site. This would be recommended, for example, where un-stocked openings exist in a Ponderosa pine stand. Adding seedlings now would help insure mature trees in the future in locations currently without recruitment trees. Any planting in Moore Park should be native species from local stock sources.

Costs associated with Hand Labor

Personnel costs for doing hand labor including: hand cutting, thinning, pruning, hand piling and/or chipping can range from $250 to over $500 an acre depending on the quantity of work to do per acre. Such work becomes the only alternative to accomplish work on terrain that equipment can not operate upon.

Initial treatments in vegetation that is decadent will be most expensive. Follow-up work to maintain the site will be considerably less expensive, particularly if prescribed fire is used.



Upper Klamath Lake
Moore Park
Link River
Percent Slope
0-25%
25-40%
40-55%
55-75%
75+%
Moore Park
Moore_rds.shp
T38S, R8E, Sections 25 and 36
T38S, R9E, Sections 30, 31 and 32
Willamette Meridian, Klamath County, Oregon
N
1000 0 1000 2000 3000 4000 5000 Feet

Appendices

Weather Station Data

Fuel Models

Fire Behavior Interpretations

BehavePlus Outputs

Weather Station Data

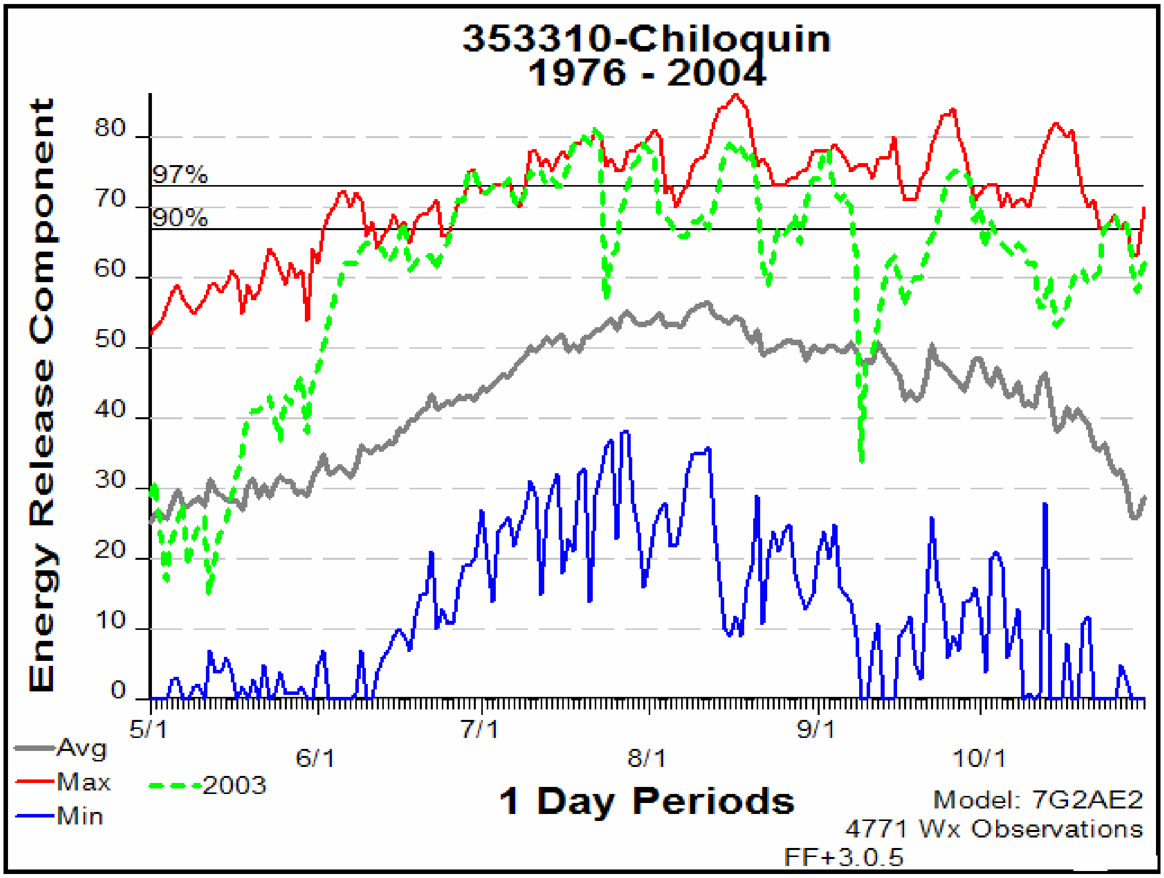
In order to supply weather data for making fire behavior predictions using the program BehavePlus the author utilized the US Forest Service Remote Automated Weather Station (RAWS) at the Chiloquin Ranger District. This station was more appropriate for winds influenced by Klamath Lake than the Gerber RAWS east of Klamath Falls, and the Parker RAWS southwest of Klamath Falls. Specific weather data is needed to make fire behavior prediction runs with the BehavePlus software. Additional information is supplied by the Chiloquin RAWS that are outputs of the National Fire Danger Rating System (NFDRS). No RAWS stations are maintained in the Klamath Falls city area as these stations are located for forest fire weather data collection. Chiloquin was the best fit for the Moore Park project.

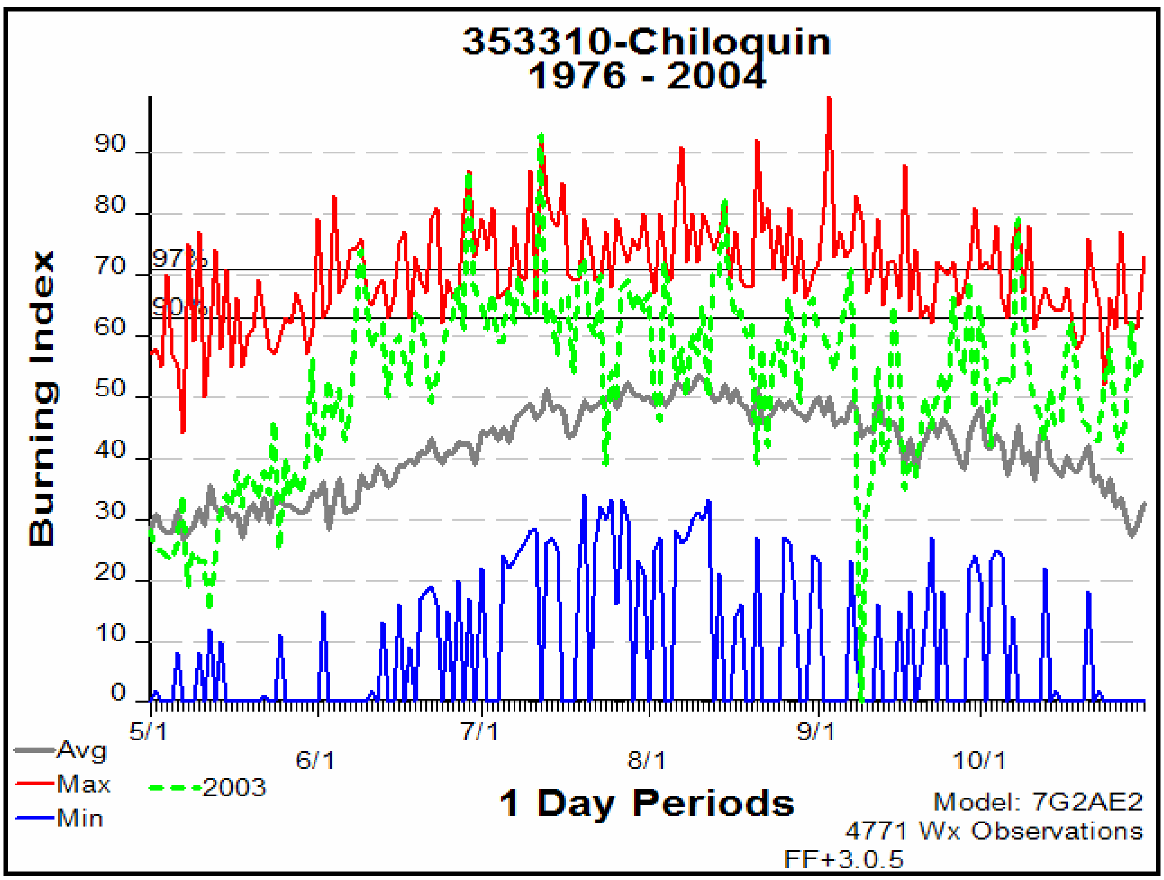
Weather station data was analyzed and graphed using the software called FireFamily Plus. This software allows rapid analysis and outputs of values from years of data.

The August 13, 2003 KAGO Fire is the most recent fire of significance to threaten Moore Park. The graph shown below is for a fire danger index called Energy Release Component (ERC). This index is used for assessing historical fire danger and making estimates of fire behavior potentials. The ERC is widely used as it is an excellent indicator of overall fire potential as it is based on the fuel moisture content of the larger dead fuels (3+ inches in diameter). These fuels are responsible for the overall intensity of a wildland fire.

Note the four colored plot lines in the graph. The green dashed line is a plot of 2003, the year of the KAGO fire. The other three colored plot lines are the maximum, average, and minimum value for ERC calculated for a given day for the years of data in the graph, in this case 1976 through 2004, or 29 years. The data is based on weather observations taken at 13:00 or 1:00 pm each day, May 31 through October 31 of each year in the data. The two horizontal lines labeled $90^{\%}$ and $97^{\%}$ are the 90^{th} and 97^{th} percentile value of ERC for the entire data set. Only 10% and 3% of the days in the data have a value above the lines, respectively. Not surprisingly August 13, 2003 was above the 90^{th} percentile level for ERC with a value of 70.

ERC is an excellent indicator of overall fire intensity potential. However, wind is a major component of wildfire spread as is not a major component of the ERC calculation. Many fire managers will additionally use another NFDRS index for analysis, the Burning Index (BI). A BI graph for the Chiloquin RAWS for the same years of data is shown below the ERC graph. Note that the green dashed plot of 2003 BI is much more sporadic than the ERC plot for 2003. This is because the BI is heavily weighted by windspeed, so the plot jumps about in response to the daily changes in wind speeds at the observation time.


353310-Chiloquin
1976 - 2004
Energy Release Component
80
70
60
50
40
30
20
10
0
97%
90%
5/1
6/1
7/1
8/1
9/1
10/1
Avg
Max
Min
2003
1 Day Periods
Model: 7G2AE2
4771 Wx Observations
FF+3.0.5


353310-Chiloquin
1976 - 2004
Burning Index
90
80
70
60
50
40
30
20
10
0
97%
90%
5/1
6/1
7/1
8/1
9/1
10/1
Avg
Max
Min
2003
1 Day Periods
Model: 7G2AE2
4771 Wx Observations
FF+3.0.5

The following values were derived from FireFamily Plus analysis of the Chiloquin RAWS data from 1976-2004. These were the environmental inputs used to make comparative predictions of fire behavior using BehavePlus software.

90th percentile values for Chiloquin RAWS 1976 - 2004								
Temp.	Relative Humidity	Windspeed	1 hour	10 hour	100 hour	1000 hour	Herb.	Woody
86 degrees F	17%	10 mph	3%	4%	8%	10%	3%	68%

The values labeled 1 hour, 10 hour, 100 hour and 1000 hour refer to fuel particles of <1/4 “, 1/4 – 1”, 1 – 3” and >3” diameter, respectively. The time is referred to as the timelag required for that fuel particle to move 2/3 of the way to equilibrium with a changed atmospheric moisture level. If the relative humidity at 10am was 60%, and was 55% at 11am, a 1 hour fuel would drop 2/3 of the moisture content it would possess at equilibrium with 55% relative humidity. This process is constantly going on throughout a day or diurnal period. It is this relationship that makes grass and fine fuels dry and combustible early in fire seasons, and makes the larger fuel not readily available until later in the season.

The column labeled “Herb.” is for herbaceous. Herbaceous fuels below 3% are considered dead and cured in NFDRS. Note: 30% herbaceous fuel moisture was used for BehavePlus runs, the 3% in the above table would be the cured state fuel moisture. The term “Woody” refers to the live, woody vegetation. 68% is a very low live woody moisture content, the shrub would be dormant.

Fuel Models

The author used the Fire Behavior Prediction System (FBPS) fuel models to make predictive outputs to support the proposed fuels treatments. The FBPS fuel models are a list of 13 choices that are selected from 4 categories: grass, brush, timber litter or slash. The definition of a fuel model is: a simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified. When describing fuel models relative to fire behavior one must always be considering the fuel that would carry a fire most readily across the given landscape.

Within Moore Park the following fuel models exist: 1, 2, 5, 6, and 9. Fuel model 10 may exist in isolated pockets and is not used for making fire behavior predictions, such pockets of increased dead, down woody debris would obviously create increased fire behavior.

Fuel Model 1

This is a mostly open, grass model. It is used for the fire behavior runs to show a relative reference line as fuel model 2 will over predict fire behavior in the juniper/pine and pine stands that lack a shrub component (either currently or after fuels treatments). Fuel model 1 would be appropriate for the grass under pine where shrubs are not contributing to the fire spread.

Fuel Model 2

This is a grass fuel model found often under an overstory of trees and/or mixed with a shrub component. This model exhibits rapid rates of spread once cured and can generate many acres of fire in a short period of time. Much of Moore Park has a fuel model 2 component or as the primary carrier of fire. The intensity of fires in this model will increase dramatically if additional woody litter is available. Where exposed this model cures and poses a fire threat for much of the mid to late summer.

Fuel Model 5

This is a brush fuel model which is often represented by younger shrubs with little or no dead wood and limited litter. Fires will only spread readily during drought conditions that have severely stressed the live plants. This model will fit the re-growth of shrubs following treatments until they have enough dead limbs and litter to be called a fuel model 6.

Fuel Model 6

Another brush model, but differs from fuel model 5 as it tends to be more flammable due to larger quantities and proportions of dead limbs and litter accumulation. Much of the decadent brush in Moore Park is this fuel model. Current treatments will generate a transitional cycle to fuel model 2, then 5, then 6 over approximately 25 years as brush species such as chokecherry and birchleaf mountain mahogany develop.

Fuel Model 9

This is a timber litter fuel model best represented by the needle, twig and cone layer found under forests predominated by Ponderosa pine. In many parts of the park this model is found combined with fuel model 2. This material has accumulated for decades in the absence of fire and would probably exhibit more dramatic fire behavior than indicated by BehavePlus.

Fire Behavior Interpretations

Flame length is defined as: the distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity. Flame length varies with wind and slope effects. It should not be confused with flame height. Flame length is a quick measure of the difficulty to control a wildfire. The recognized standard for assessing fire suppression capabilities by observing flame length is in the following table.

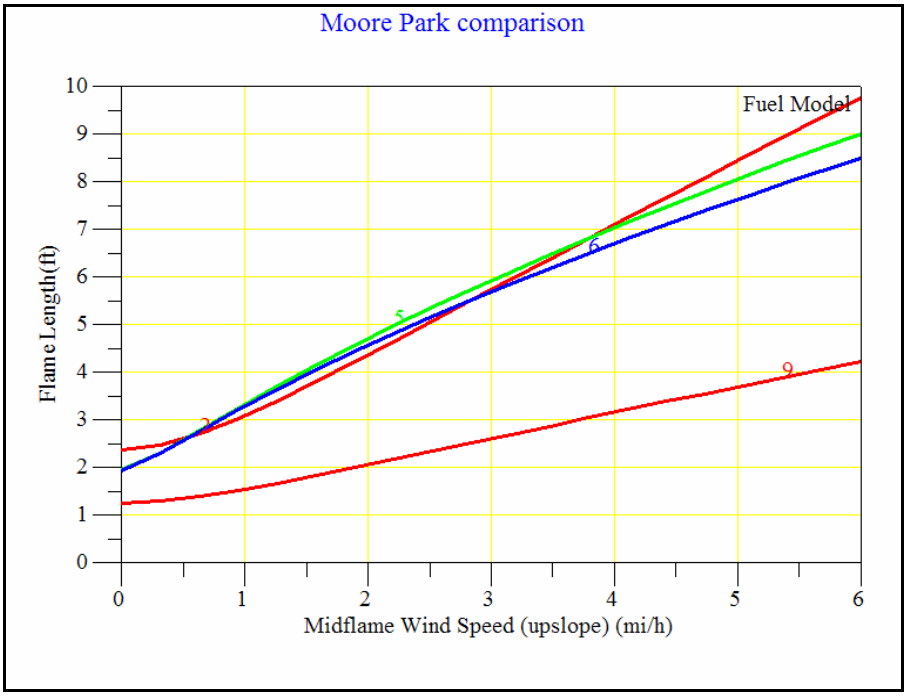
Flame Length (ft.)	Interpretation
0-4	Fires can generally be attacked at the head or flanks by persons using hand tools. Handline should hold the fire.
4-8	Fires are too intense for direct attack on the head by persons using hand tools. Handline can not be relied on to hold fire. Equipment such as dozers, engines, and retardant aircraft can be effective.
8-11	Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.
11 +	Crowning, spotting, and major runs are common, control efforts at the head of the fire are ineffective.

BehavePlus Outputs

There are some significant assumptions in the Rothermel spread equation, which is used to generate outputs in the Behave and BehavePlus programs. Fuels, weather and topography are basically assumed to be constant. Fire spread is assumed to be at a quasi-steady state. The fire is spreading in surface fuels, the rate-of-spread output does not consider spread by torching and spotting.

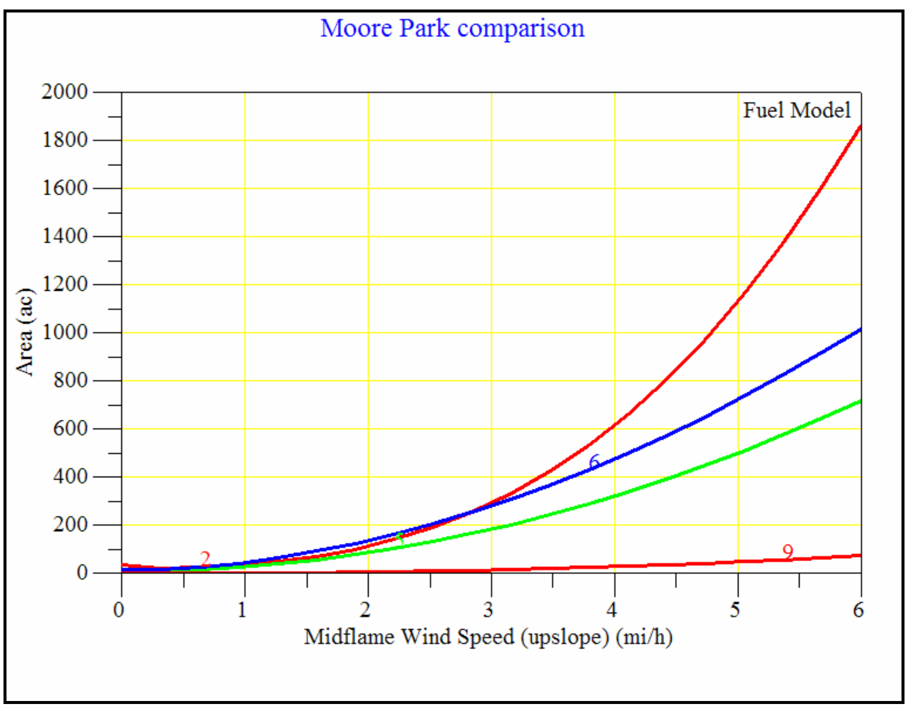
These scenario runs in the BehavePlus software are used as relative illustration only. Considerable experience with actual wildland fire behavior is needed to reasonably interpret and calibrate predictions from the software.

The following are captured from BehavePlus predictive runs. This first set was made using the 90^{th} percentile weather, which is an extreme fire weather scenario. The weather conditions used are similar to the conditions on the day of the KAGO Fire in 2003. There are some subsequent graphs showing the behavior expected on a more typical fire season day. The graph showing fire size in acres is based on a three hour fire run, roughly the timeframe of the 2003 KAGO Fire run. The size difference between the observed KAGO fire and the predictions on the graph are due to the model assumptions, the actual fuels burned were not the continuous layer that the model assumed.



Graph 1

Graph 1 shows the flame length as wind speed increases for the 4 fuel models previously mentioned. Note the similarity between fuel models 2, 5 and 6 versus the slower response of fuel model 9. Also notice that the 4 foot flame length is quickly achieved by fuel models 2, 5 and 6 due to the extreme fire weather conditions in the 90th percentile inputs.

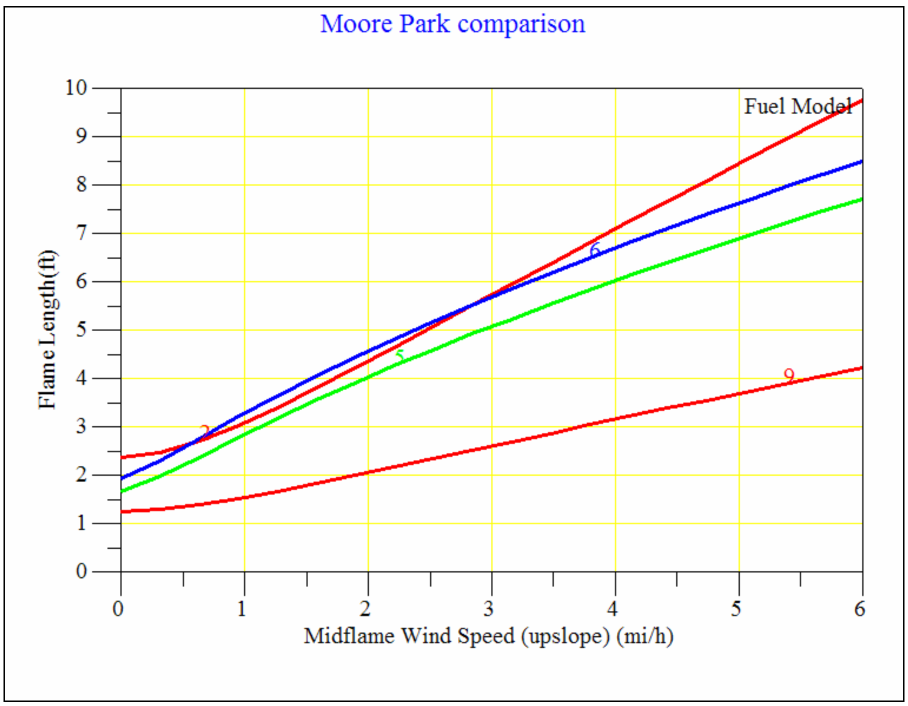


Graph 2

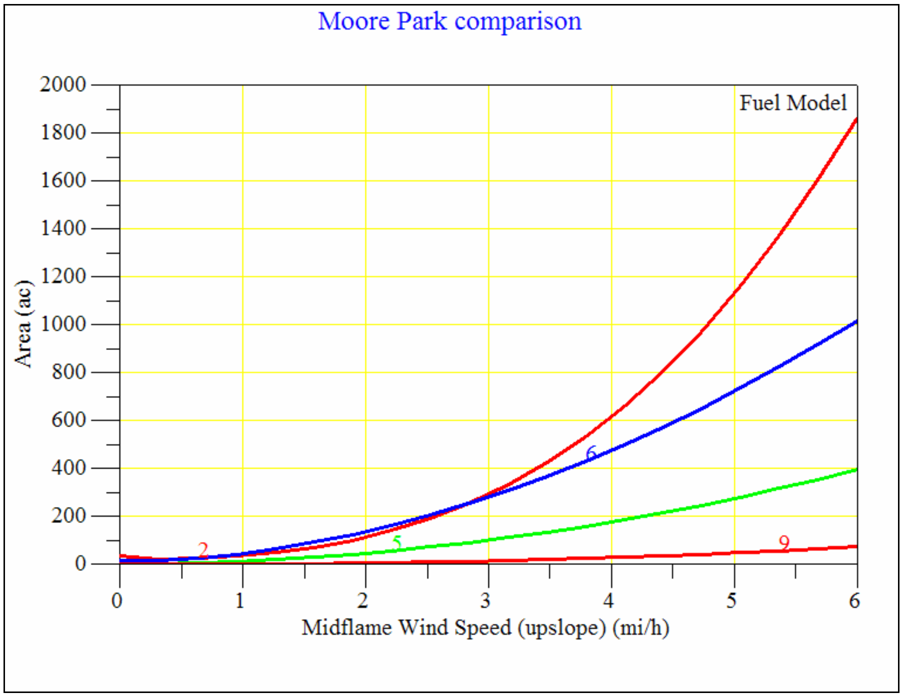
Graph 2 shows fire size reached in three hours at midflame (eye-level) winds ranging from 0 to 6 mph. Note the slow acreage growth in fuel model 9, the target condition for the much of the interior Ponderosa pine in Moore Park.

The treatments proposed include thinning of trees focusing on ladder fuel situations and pruning of selected leave trees. This condition will significantly lower the probability of torching and crown fire behavior. The remaining grass, fuel model 2, will be capable of a rapid rate-of-spread fire, but of much less intensity than a fire able to move through the shrub component presently represented by decadent brush in Moore Park. The ultimate objective of the fuels treatments is to lower the impact of a wildfire to the overstory trees. A tactical benefit is that grass fires, although fast moving, are more readily knocked down by traditional engine attack methods.

Graphs 3 and 4 are based on the same weather as the first two, but the live woody fuel moisture has been increased to 100 %, a more typical level for young re-growing brush the first many years after a treatment in decadent brush.



Graph 3



Graph 4

Note that the green curve for fuel model 5 has fallen compared to the Graphs 1 and 2 which were produced with the 90th percentile weather inputs. This curve would still represent an over prediction of fire size as the model assumes a continuous layer of flammable brush. The re-growing shrub component in Moore Park would take years to approach the density being modeled by the green curve for fuel model 5.

Scorch Height

Graph 5 and 6 show outputs of scorch height with fuel models: 1, 2, 5, 6, and 9.

Graph 5

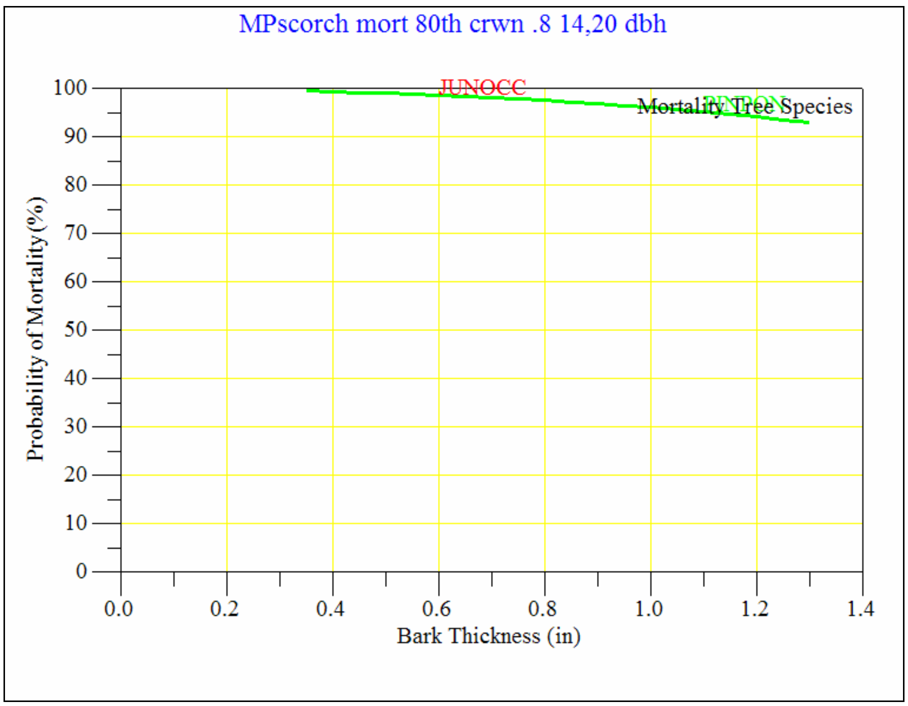
Graph 6

There is little difference in scorch heights by fuel model between 90th and 80th percentile weather. The next graphs will compare the mortality predictions using the 80th percentile weather representing the 30 worst days of a fire season (May 31 through Oct 31). Note the scorch heights for any fuel model with a shrub component in it: 2, 5 or 6.

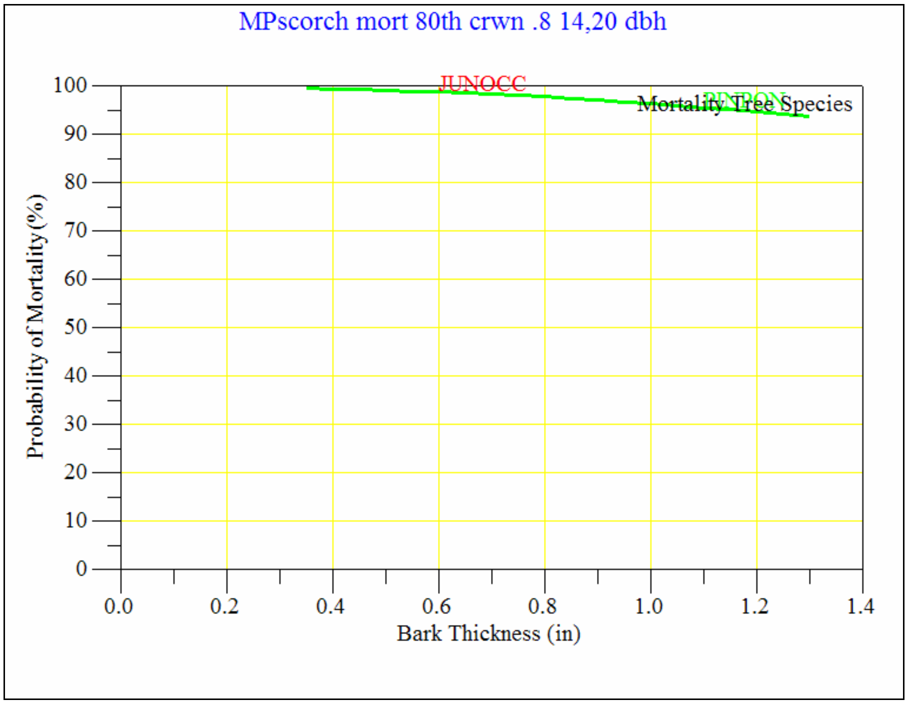
Mortality

The following graphs, 7-10 show the mortality in percent for an overstory of 14" diameter breast height (dbh) juniper and 20" dbh Ponderosa pine with un-pruned crowns. Smaller diameter trees would experience a higher percentage of mortality. Larger diameter trees would experience a lower percentage of mortality.

Note: The fire spread model is assuming a head fire running at full intensity, a prescribed burn would have lower mortality through weather conditions and ignition technique. Burns done with Spring-like or Fall conditions using protective measures (raking, foam) and backing fire away from trees using ignition techniques such as spot or ring firing will greatly enhance the survivability of the desired trees.

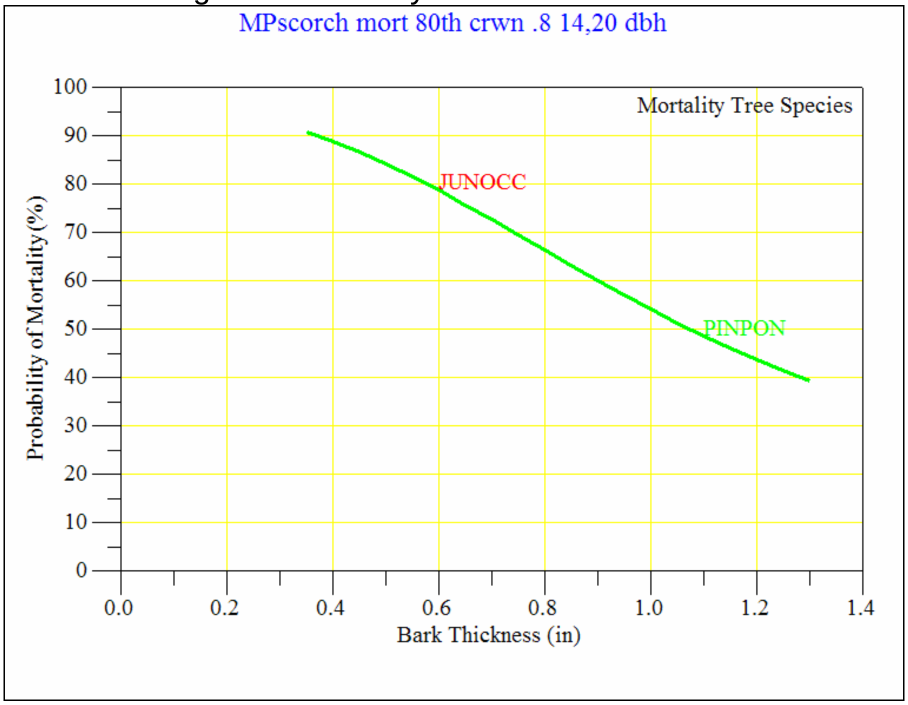


Graph 7 – Fuel Model 6

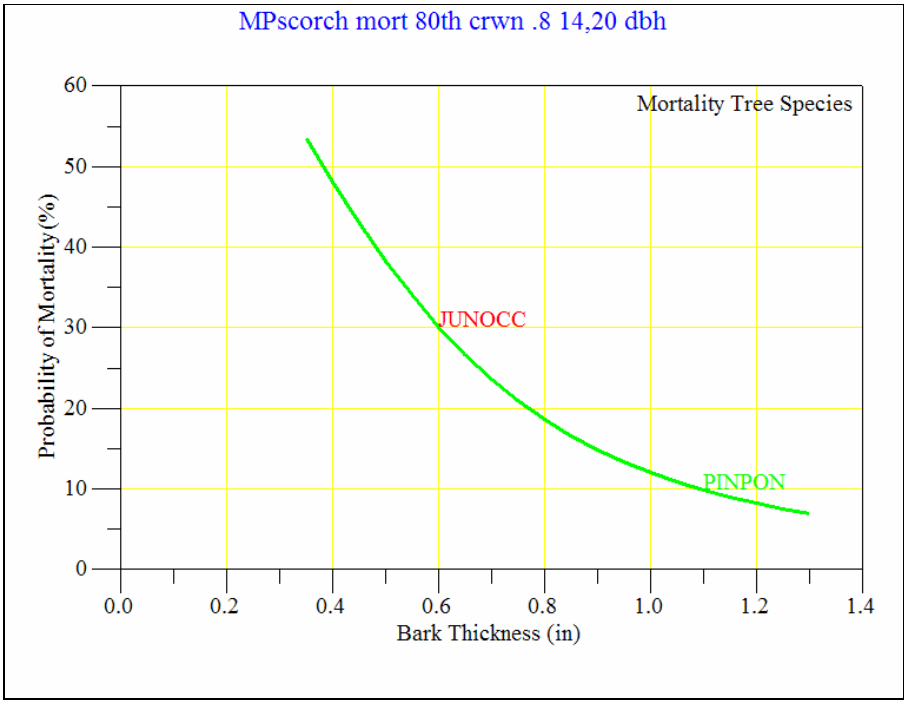


Graph 8 – Fuel Model 2

Note the similar mortality values for fuel model 6 and 2, both with a shrub component contributing to fire intensity.



Graph 9 – Fuel Model 1



Graph 10 – Fuel Model 9

Graphs 9 and 10 represent the target condition in the Ponderosa pine and mixed juniper/pine stands in vegetation type islands 4, 6, 9 and 10. Tree spacing via thinning and pruning will further enhance the survivability of the overstory trees.

References

Albini, Frank A. 1976. Computer-based models of wildland fire behavior: a user's manual. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 68 p.

Anderson, Hal E. 1982. Aids to determining fuel models for estimating fire behavior. USDA Forest Service General Technical Report INT-122, 20 p.

Andrews, Patricia L.; Bevins, Collin D.; Seli, Robert C. 2005. BehavePlus fire modeling system, version 3.0: User's Guide. Gen. Tech. Rep. RMRS-GTR-106WWW. Ogden, UT: Department of Agriculture, Forest Service, Rocky Mountain Research Station. 142 p.

Andrews, Patricia L. 1986. BEHAVE: fire behavior prediction and fuel modeling system--BURN subsystem, Part 1. Gen. Tech. Rep. INT-194. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 130 p. (NFES 0276)

Andrews, Patricia L.; Chase, Carolyn H. 1989. BEHAVE: fire behavior prediction and fuel modeling system--BURN subsystem, Part 2. Gen. Tech. Rep. INT-260. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 93 p. (NFES 0277)

Burgan, Robert E.; Rothermel, Richard C. 1984. BEHAVE: fire behavior prediction and fuel modeling system--FUEL subsystem. Gen. Tech. Rep. INT-167. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 126 p. (NFES 0275)

Burns, Thomas A. 1999. Klamath/Lake forest health management guide. Klamath/Lake Forest Health Partnership and Klamath Ecosystem Education Partnership. 154 p.

Calonje, Christopher.: Rabe, Andrea. 2004. Special status plants of Klamath County, Field Identification Handbook, 78 p.

Fire in Oregon's Forests: Assessing the risks, effects and treatment options, 2002. Oregon Forest Resources Institute. 16 p.

Fire Family Plus User's Guide, ver 3.0, 2002. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Lab, Systems for Environmental Management, 124 p.

Fitzgerald, Stephen A. 2002. Fire in Oregon's forests: risks, effects, and treatment options, a synthesis of current issues and scientific literature. Oregon Forest Resrouces Institute. 164 p.

Rothermel, Richard C. 1972. A mathematical model for predicting fire spread in wildland fuels. Res. Pap. INT-115. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 40 p.

Scott, Joe H.: Reinhardt, Elizabeth D. 2001. Assessing crown fire potential by linking models of surface and crown fire behavior. Res. Pap. RMRS-RP-29. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 59 p.