EXECUTIVE SUMMARY

Investigation of Alternative Strategies for Design, Layout and Administration of Fuel Removal Project

Final Report under USFS Grant WNFP 01-015

June 30, 2003

Larry Mason, Heather Rogers, Bruce Lippke, Kevin Ceder, Tom Bloxton,
Jeffrey Comnick, Jim McCarter, Kevin Zobrist

Rural Technology Initiative (RTI)
College of Forest Resources
University of Washington

Abstract

Forest fuel reduction treatments are needed, as demonstrated by the increased number of devastating crown fires and annual increases in National Forest acres categorized as high risk. This report develops analysis components for effective fire risk reduction strategies to help professionals, publics, and policy-makers gain a better understanding of the current circumstances and alternatives. A range of thinning strategies were simulated and evaluated for the Okanogan and Freemont National Forests providing a set of results for comparative climatic and infrastructure conditions. Measures of fire risk reduction, economic cost, habitat protection, and carbon sequestration were evaluated, to develop the basis for characterizing both market and non-market values resulting from forest fires and fire risk reduction activities. The market cost of removing enough small diameter material to reduce fire risk sometimes exceeds the market value for the material removed. However, non-market benefits of reduced fire fighting and rehabilitation costs, facility losses and fatalities, protected habitats, sequestered carbon, saved water and other public values appear to more than offset treatment costs. Contracting alternatives and infrastructure needs are also evaluated. Treatment strategies can be customized to local forest and market conditions, providing the basis for management training as well as public education.

Acknowledgements: This work was made possible by a Community Assistance and Economic Action Program Grant WNFP-01-015 within the Multi-Agency National Fire Plan administered by USDA-Forest Service. The Freemont and Okanogan National Forests collaborated by providing forest inventory data and operational data on fires and management costs. Chelan County Public Utility District, the TurboSteam Corporation and Collins Pines collaborated on biomass production of energy information. Many local people from the USDA Forest Service, WA DNR, OR Department of Forestry, the Ecosystem Workforce Program, Sustainable Northwest, Lake County Resource Initiative, Okanogan Communities Development Council, Defenders of Wildlife, American Forest Resource Council, WA Contract Loggers Assoc., Oregon Associated Loggers, nineteen logging companies, nine sawmills and many other community representatives and interested individuals generously shared useful information relating to forest conditions, fuel reduction activities, the local infrastructure, contracting suggestions, harvest costs, and market information. The carbon analysis benefited by supplemental funding provided by Columbia Pacific RC&EDD and EPA to demonstrate carbon tracking in response to forest management alternatives. The modeling capabilities also benefited by linking the findings of the Consortium for Research on Renewable Industrial Materials (www.CORRIM.org) with the Landscape Management System, a landscape planning system used extensively in the project and developed at the University of Washington (http://lms.cfr.washington.edu). Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the funding agencies or information providers.

EXECUTIVE SUMMARY

Investigation of Alternative Strategies for Design, Layout and Administration of Fuel Removal Projects

Management Strategies

The Okanogan and Fremont National Forests (ONF & FNF) were selected as case study areas to evaluate a range of management treatments that could reduce fire risk. They provide a north to south range in climate as well as substantially different market infrastructures. Forest inventory data were assembled from the Continuous Vegetation Survey (CVS) with 502 plots for FNF and 413 plots for ONF suitable for the analysis. Simulations of alternative treatments were produced using the Landscape Management System (LMS) developed at the Silviculture Laboratory of the College of Forest Resources, University of Washington in cooperation with the USDA Forest Service. For this investigation, LMS is used with the Forest Vegetation Simulator (FVS) as the growth model and the Fire and Fuels Extension (FFE), both developed by the USDA Forest Service. LMS also provides numerous habitat suitability and forest diversity measures, carbon sequestration measures and log production algorithms for economic analysis. This array of LMS outputs provides a consistent suite of metrics for measuring the critical influences of both fire and fire risk reduction management strategies.

Four thinning treatments were modeled: (1) removal of all trees with a DBH less than or equal to nine inches (***9 and under***); (2) thin from below (smaller trees first) removing 50% of the original basal area/acre (***Half BA***); (3) thin from below with a residual basal area target of 45 ft^2/acre favoring ponderosa pine and western larch (***BA 45***); and (4) removal of all trees with a DBH greater than or equal to 12 inches to simulate a high revenue alternative (***12 & over***). In addition, (5) a no action alternative (with no disturbances) was developed (***No action***) and (6) a crown fire representative of each forest (***Wildfire***). All simulations were treated in 2000 and simulated growth of post-treatment inventories was modeled forward to 2030, without understory regeneration to mimic the impact of periodic controlled burns (or other fuel removals) and with understory regeneration to simulate natural ingrowth. Twelve total alternatives were simulated and analyzed for each of the 915 surveyed locations.

Fire Risk Assessment

Pre-treatment risk assessments indicated that 77.7% of the FNF plots and 76.8% of the ONF plots were at moderate to high risk of crown fire. This risk index is based upon the estimated wind speed in miles per hour (mph) at 20 feet off the ground needed to initiate an active crown fire from a surface fire. Wind speed estimates less than or equal to 25 mph were considered to be in a high fire risk category and from 25 through 50 mph in a moderate risk category. Estimates over 50 mph were considered low risk.

Treatment Results

The table below displays example risk reduction performance of treatment alternatives for the subset of FNF plots considered at high risk.

Post-treatment risk reduction in FNF high risk stands

Treatment	High risk	Moderate Risk	Low risk
No action	100%	0%	0%
9 & under	37%	48%	15%
Half BA	7%	66%	27%
45 BA	2%	27%	71%
12 & over	80%	20%	0%
Wildfire	0%	0%	100%

Thinning only 9inch and under trees leaves 85% of the beginning high risk stands in a moderate or high risk category whereas retaining 45 BA almost eliminates the high risk with 29% in a moderate or high risk. Removing trees over 12 inches converts a few stands from high to moderate risk but none to low risk. Selection of best treatment alternatives can be customized to site conditions; however, removing some trees in the 9-12 inch diameter range is usually required for a substantive reduction in fire risk. With overstory trees retained and the understory re-established, fire risks return within 15-20 years.

Market Economics

Cost estimates for logging operations and treatment yield volumes are both site and equipment specific. As a result there is a significant range of variability in net revenue across all stands for the same treatment strategy. In addition, harvesters report that operations under federal contracts are uniquely costly indicating that refinements in federal contract requirements could reduce costs. Although the BA 45 treatment failed to generate the net economic returns of the 12 and over treatment, it produced the greatest risk reduction and, with low cost assumptions, provided a positive net return.

FNF average net revenue by treatment per acre.

Treatment	High cost	Low cost
9 & under	$-374	$-134
Half BA	$-319	$+139
45 BA	$-168	$+529
12 & over	$+1,244	$+2,198

The range of net revenues across all stands and treatments is quite large ($-2,015 to +11,414) indicating opportunities to customize treatments to specific conditions. Stands with positive revenues offset losses on other stands in this analysis of average impacts. A simple tradeoff between fire risk reduction and economics suggests treatment strategies can use positive revenue sites to compensate for revenue negative stand treatments. However, there may be other environmental considerations of importance as well. Habitat and carbon sequestration are both considered of high value by society. Additionally, there may be other economic values that are not reflected in treatment costs. Consideration of broader values of fire risk reduction provides a much more powerful motivator for fire risk reduction than looking only at net market revenue.

Wildlife Habitat

Treatments can substantially affect stand structure and, as a consequence, the habitat quality. Fires generally have a more extreme impact on habitat than any treatment. While the No action

alternative might seem to benefit some species of wildlife, it assumes an unlikely eventuality of no fire and implicitly produces overstocked conditions different from pre- settlement forests with frequent fire return intervals. The impacts of the other treatments on habitat are mixed with some species benefiting at the expense of others. Habitat strategies associated with fire risk reduction are inherently local and need to be integrated into other objectives. Goshawks favor high-risk forests that are neither sustainable nor characteristic of pre-settlement conditions but their habitat can benefit from light thinnings and from avoidance of crown fires. The Lewis woodpecker can benefit from heavy thinnings if the largest trees and snags are retained. The Williamson's sapsucker needs soft snags making it very susceptible to fires. Pileated woodpeckers favor multi-story old forests, which are currently uncommon in the ONF or FNF. Retention of large trees and snags over time would eventually improve habitat for woodpeckers. The grizzly bear avoids stem exclusion structures and would favor a mix of treatments that reduces the dominance of overly dense stands. Analysis of the alternatives provides the opportunity to identify better habitat strategies in concert with other objectives and local conditions.

Carbon Analysis

Carbon is sequestered in the forest, and contributes undesirable emissions with fire, but is also stored in wood products for long periods. When biomass is converted to energy it displaces fossil fuels reducing carbon emissions. The 12 inch & over treatment produces the most flow of products and hence the most carbon sequestration but does not reduce the fire risk and is not sustainable. The BA 45 treatment produces the next highest level of carbon sequestration, reduces fire risk and is sustainable; in addition, much of the carbon is stored in products displacing energy-intensive substitute products like concrete and steel. As carbon credit markets are developed, they may contribute to treatment costs, paying for otherwise unprofitable treatments. Carbon is just one of the non-market benefits that result in positive values from fire risk reduction strategies.

Value Changes Associated with Fire Risk Reduction

While it is generally recognized that there are many non-market values that should be associated with fire risk reduction treatments, they are rarely articulated. With numerous outputs tabulated for each management strategy, it is possible to begin to put numbers on many non-market values. The tables below provide a conservative comparison of values and costs for fire risk reduction in high and moderate risk forests. The benefits appear to far outweigh the costs, providing motivation for more aggressive fire risk reduction efforts than have been undertaken to date.

Market and Non-Market Values of Fire Risk Reduction/acre	Moderate	High
Reduced fire fighting cost	$231	$481
The value of reduced facilities losses	$72	$150
The value of reduced fatalities	$4	$8
The value of lost timber amenities	$371	$772
Habitat losses	?	?
The community value of fire risk reduction	$63	$63
Carbon credits	$20	$41
Green energy credits	?	?
Electrical transmission cost reductions	?	?
Regeneration and rehabilitation costs	$58	$120
Water quantity and quality	$86	$86
Regional economic benefits	$386	$386
Total Benefits	**$1,291**	**$2,107**

Costs of Fire Risk Reduction/acre	Moderate	High
Operational costs	$374	$374
Forest Service contract preparation costs	$206	$206
Soil compaction	?	?
Sedimentation	?	?
Impacts to wildlife habitats	?	?
Total Costs	**$580**	**$580**

While some non-market values have not been estimated, most appear to have lower order impacts and would probably not affect conclusions. While the value society places on habitat should be at least as high as the market revenue foregone, which can be roughly estimated from the 12 inch & over treatment revenue, habitats are more likely protected by treatments that avoid fire than by No action and should be significantly positive with more sustainable management.

Cogeneration Opportunity

Applying non-market values to motivate increased fire risk reduction treatments or selecting treatments that come close to breaking even does not by itself create a use for the lowest valued small diameter material harvested. Cogeneration in any number of forms adds value in the conversion of low-valued biomass to energy and can be considered a default use of material when higher-use markets are unavailable. Forest inventory analyses indicate that opportunities for cogeneration development exist on both forests. The primary limitation is assured access to sufficient biomass to warrant cogeneration investments. This raises the importance of contracting relationships and the sustainability of fire risk reduction planning.

Sustainability and Contracting
The Forest Service has generally been stymied in the process of completing environmental reviews and arranging contracting where costs and revenues are not directly related to positively valued timber markets. Stewardship End Result Contracts are being developed to allow negative revenue risk reduction operations that provide benefits such as contract longevity to support investments of risk capital in needed infrastructure.

Uses of the Report
This report provides parametric data on treatments that reduce fire risk, including their costs, market values, non-market values, and contracting issues. Specific examples can be used to customize strategies for a wide range of forest, infrastructure and market conditions. The information is also useful in training operators on how to design and layout fuel reduction treatments.

This report also demonstrates how an integrated forestry software package can assist federal agencies and other interested users in gaining greater efficiencies in planning fire risk reduction treatments to achieve multiple values with less conflict and less cost. The Landscape Management System (LMS) provides a sophisticated user-friendly software environment from which professional and public users with little training can participate in analysis of complex data to better understand the consequences of management alternatives. The results from case study analysis of two National Forests, presented in this report, demonstrate that fire risk can be effectively reduced while creating and protecting other positive environmental, economic, and social values.