Discussion Paper 10 (DP10): Benefits/Avoided Costs of Reducing Fire Risk on Eastside

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Introduction

This paper summarizes earlier studies (Mason et al 2003 and 2006) and a variant published by the Forest Health Strategy Work Group as a response to Senate Bill 6144 (WADNR 2004a).

Costs Associated with Forest Fires:

An analysis of fire risk and hazardous forest fuels on the Fremont (OR) and Okanogan (WA) National Forests indicates that the negative impacts of crown fires are underestimated and the benefits of government investments in fuel reductions are substantial. Perhaps most obvious is the escalating cost of fighting forest fire, which nationally has been in the billions of dollars during recent years. In 1991, the Forest Service spent 13 percent of its total budget on wildland fire management. In 2006, 45 percent of the agency's budget went to fighting fire (Backus.2007). Similarly, there is the value of avoiding facility losses and fatalities that result from forest fires. Communities value a lower fire risk and reduced smoke. Forest fires destroy visual aesthetics and limit recreational opportunities. The United States Congress has historically placed a very high value on species protection as evidenced by laws such as the Endangered Species Act or the National Forest Management Act yet irreplaceable habitats for threatened and endangered species may be lost when forest fires are more destructive than historical norms. Valuable timber resources are destroyed. Fires also convert the carbon stored in forest biomass to smoke reducing the opportunity to produce long lasting pools of carbon stored in forests and products while adding to greenhouse gas emissions and global warming. Fires consume biomass that otherwise could be used for clean energy conversion and green energy credits.

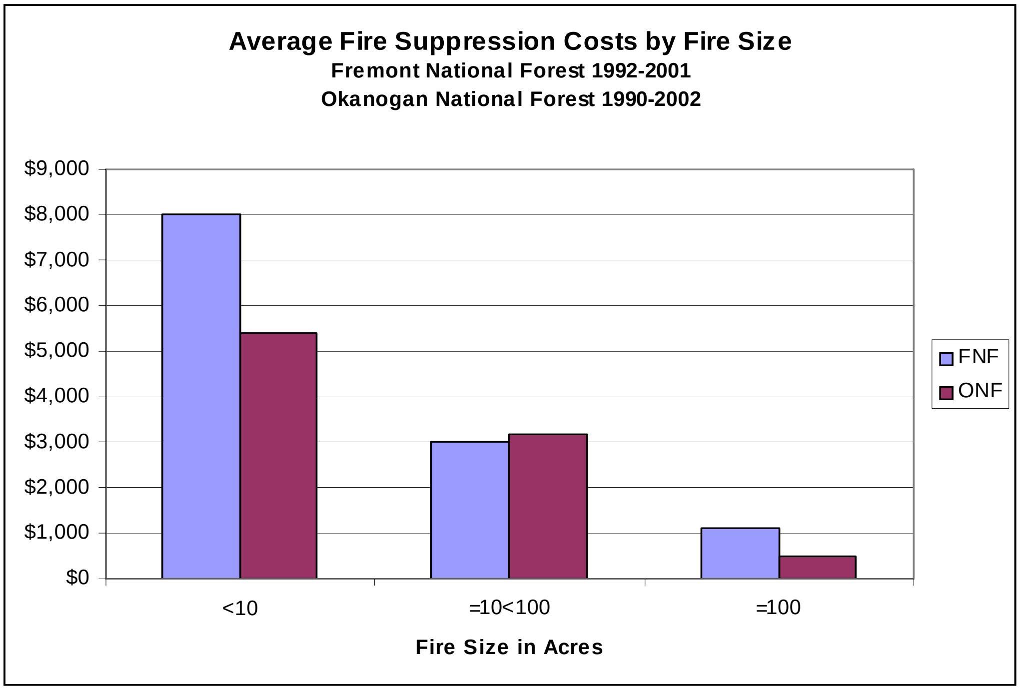

Figure DP10.1: Average fire suppressions costs - Fremont and Okanogan National Forests.

Regeneration after fires is problematic and costly and rehabilitation investments are often needed to avoid serious erosion, sedimentation, and water contamination. If forests are thinned, the resulting increase in available surface water could benefit salmon habitats, municipal reservoirs, and agricultural irrigation. Rural economic development benefits would result from the taxes and rural incomes generated by fuel reduction activities. Since economic activity in these regions has been in decline as a consequence of lower federal timber harvests, any reduction in unemployment has higher than normal leverage on state and local finances by lowering assistance costs.

Estimating the Avoidable Costs of Destructive Fires:

Many scientific studies have shown that forests thinned to remove fuel loads are unlikely to experience crown fires (Agee 1993, Graham et al. 2004, Kalabokidis and Omi 1998, Keyes and O'Hara 2002, Omi and Martinson 2002, Peterson et al. 2005, Pollet and Omi 2002, Sandberg et al. 2001, WADNR 2004, Western Governors Association 2001 and 2002). Accounting for the full value of this reduced risk exposure, however, must take into consideration both the predicted costs and the timing of future fire events. While it is impossible to predict exactly when a future fire might occur in a specific location, we do know that due to decades of fire suppression, the time since last ignition in many forests is well beyond previous fire return cycles and that present fuel loads are well outside of historic levels. Fire ecologists agree that the question is not whether these forests will burn but when. To illustrate how the relative costs and benefits of investments in hazardous fuels removal treatments to reduce risk of crown fires might be considered, a parametric table can be constructed to display the present value of anticipated future costs associated with failure to reduce risk (Figure DP10.2). For this example, we will assume that all acres of forests with a present high risk, if left untreated, will burn sometime in the next 30 years while all those forests considered at moderate risk will burn sometime in the next 60 years. If there is an equal probability of each acre burning in any year during the assigned interval then for approximation purposes we can assume that an average time for all acres to burn is equivalent to one-half the interval. More complex models have been evaluated producing similar results.

Non-market Valuations

$$V_0 = \frac{V_n}{(1+i)^n}$$

Where:

V_0 = present value at time 0

V_n = future value after n periods (years)

i = interest rate

n = number of periods (years)

Parametric Present Value Estimations of Fire Risk Costs with Assumptions of $1000/acre to Fight Fire and 5% as the Discount Rate.

For this Exercise Assume all High Risk acres burn in 30 years (15 year midpoint) and all Moderate Risk acres burn in 60 years (30 year midpoint).

Year	5	10	15	20	25	30	35	40	45	50	55	60
Method 1. Present cost/ac of a forest fire at specified future year	$784	$614	$481	$377	$295	$231	$181	$142	$111	$87	$68	$54

Figure DP10.2: Parametric present value estimations of future costs.

With an equal probability that all acres burn sometime in 30 years, the average time to burn is 15 years and correspondingly, with a 60-year interval, the average burn time will be 30 years. If we further assume, as is often done for financial analysis, that an inflation-adjusted interest rate of five percent is representative of the average anticipated cost of money throughout the risk interval then we have what we need to discount future cost estimates to present dollars. In the example above, an estimated future average fire fighting cost of $1000 per acre is used to demonstrate the present value of a future liability. This example shows that, assuming a $1000/acre fire fighting cost, every dollar that will be needed to fight forest fires during the 30-year period for high risk represents $0.48 of anticipated cost exposure today and during the 60-year period for moderate risk represents $0.23 today. Conversely, investments in fuels removals today are worth the savings represented by these present value estimates of costs avoided if fires do not occur. Other non-market values of interest can be similarly assessed and then summed to estimate broader present benefit from investment in risk avoidance.

The following table shows present value estimates of avoided future losses associated with a number of market and non-market values. Also displayed for comparison are Forest Service contract preparation costs and operational costs. Future values are taken from a variety of governmental and non-governmental information sources while contract and operational estimates are derived from average Forest Service timber sale preparation costs (Bosworth 2003) as well as from interviews with Eastern Washington harvest contractors. Treatments are assumed to be conservative fuel reductions within the understory that remove only those trees nine inches and less in diameter at breast height. A more rigorous explanation of this estimation methodology and source information can be found in the publication *"Investigation of Alternative Strategies for Design, Layout, and Administration of Fuel Removal Projects"*, in the Market and Non-Market Values section, at www.ruraltech.org (Mason 2003).

Table DP10.1: Summary table of costs and benefits from fire risk reductions

Treatment Benefits	Value per acre	
	High Risk	Moderate Risk
Fire fighting costs avoided	$481	$231
Fatalities avoided	$8	$4
Facility losses avoided	$150	$72
Timber losses avoided	$772	$371
Regeneration and rehabilitation costs avoided	$120	$58
Community value of fire risk reduction	$63	$63
Increased water yield	$83	$83
Regional economic benefits	$386	$386
Total Benefits	**$2,063**	**$1,268**
Treatment costs		
Operational costs	($374)	($374)
Forest Service contract preparation costs	($206)	($206)
Total Costs	($580)	($580)
Positive Net Benefits from Fuel Removals	**$1,483**	**$706**

Additional benefits from fuels reductions such as habitat restoration, water quality protection, carbon credits, and others are more difficult to estimate but are generally considered to be of high public value. Further research is needed to quantify such benefits; however, it should be apparent that addition of such considerations would serve to increase further the net value of public investments in forest fire risk reduction.

Potential negative offsets to these avoided costs that might be associated with harvest activities to reduce hazardous fuel loads should also be considered, including environmental impacts of soil compaction, damage to leave trees, and road sediments. In general these costs can be avoided with due diligence. Fuel reduction treatments may compromise habitat quality for some species while improving it for other species, creating trade-offs that are difficult to evaluate. In making such evaluations, it is necessary to factor in an increasing risk of catastrophic wildfires on the very acres we are endeavoring to protect for their habitat values. Thinning may compromise habitat quality, but does not eliminate it as a stand replacing wildfire would. Additionally, thinning treatments can be scheduled and designed to reduce negative impacts on habitat as much as possible as implemented by the DNR HCP Amendment #1 (WADNR, 2004b).

While the values assigned to the benefits from fuels reductions that have been listed above can rightly be considered coarse estimates, they have been shown to be legitimately defensible and intentionally conservative. These figures suggest that the benefits of fire risk reduction are of high value and generally of much higher value than any market losses resulting from thinning to reduce the fire risk. It is worthy to note that many areas of the forests examined for fuels reduction showed positive net returns from log sales when thinning simulations included removal of some larger trees as part of the fuels reduction activity. However, even with an assumed net cost of fuel reduction operations, the results of this cost/benefit analysis clearly show that the future risk of catastrophic fire is far costlier to the public than investments made today to protect against such eventuality.

Magnitude of Potential Benefits

An analysis of Fremont and Okanogan National Forest inventory data indicated that 1,307,667 acres (greater than 75 percent of the total forest area) are at moderate to high risk of crown fire. Based upon present value estimations above, the total no-action liability for these at-risk forests is greater than two billion dollars. The net public benefit of hazardous fuels reductions after subtraction of operations costs for just these two National Forests is estimated to be greater than 1.3 billion dollars.

Fire Preparedness, Suppression, and Prevention Costs

Fire Fighting Costs

The cost of fighting fires is large compared to any effort by those responsible for fighting fires to prevent fires. Figure DP10.3 shows that fire preparedness costs (personnel and equipment) for DNR protected land have increased over the last two biennia largely in response to a more than doubling of fire suppression costs. Over the last two biennia, fire suppression costs have increased by $25 million to reach almost $60 million per biennium. Fire suppression costs are more random from year to year than preparedness costs depending upon drought and other weather conditions.

Figure DP10.4 shows that the fire suppression costs per acre burned appear to have more than doubled over the last several years from just under $1,000 per acre to over $2,000. This is twice as high as the suppression cost reported for Okanogan/Wenatchee National Forest. Table DP10.2 shows the suppression cost for the Okanogan/Wenatchee National Forest as a function of the number of acres burned. While the cost is very large for small tracts it is somewhat lower for the very large tracts. Federal forests tend to have larger blocks of contiguous acres, which are also generally at greater distance from populated areas so the suppression activity can be less concentrated on larger tracts. The increasing costs for smaller fires makes it clear that suppression activities are targeted at putting out fires with the per acre cost of fires only reduced by those that get out of control and become very large.

While there is some funding devoted to prevention activities such as education and technical assistance, the amounts are minimal relative to the cost of preparing to fight fires and trying to suppress them once they start, and these suppression costs do not include the costs associated with the damage created by fires and post-fir restoration activities.

Investing in Treatments to Reduce Costs

The cost of thinning treatments that would reduce the risk of fires represents an investment that would be expected to lower the cost of fighting fires over time. If other non-market values are considered, the benefits can be expected to exceed the investment in treatment costs very quickly. Even if just the avoidance of future firefighting costs is considered as a payback for the treatment cost there will likely be a positive benefit for treating high risk acres since the probability of preventing a fire by treatment increases year after year i.e. the treated acre would eventually have been in the path of a fire.

The cash flow or value benefit of avoiding firefighting costs and producing other non-market benefits is shown in Figure DP10.4. The returns from the investment cost of thinning a high fire risk stand turn positive in as little as three to four years when many of the identified non-market benefits are included. When avoided costs and protected non-market values are compared to investments in fuel reduction activities, the pay back to society results in positive value benefit of approximately $1000 per acre in about 10 years.

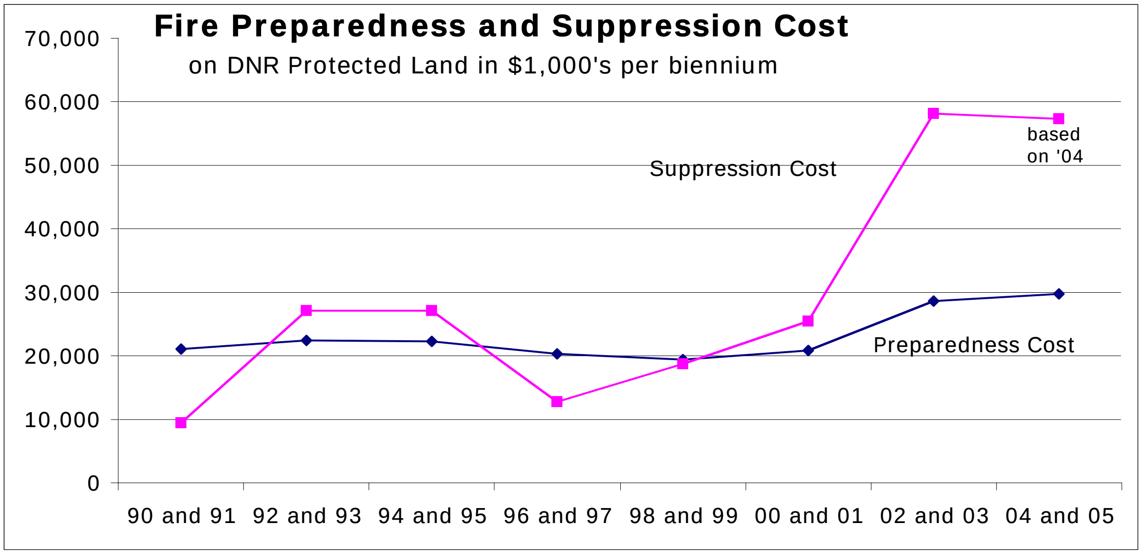

Figure DP10.3: Fire preparedness and suppression cost per biennium DNR 1990-2005

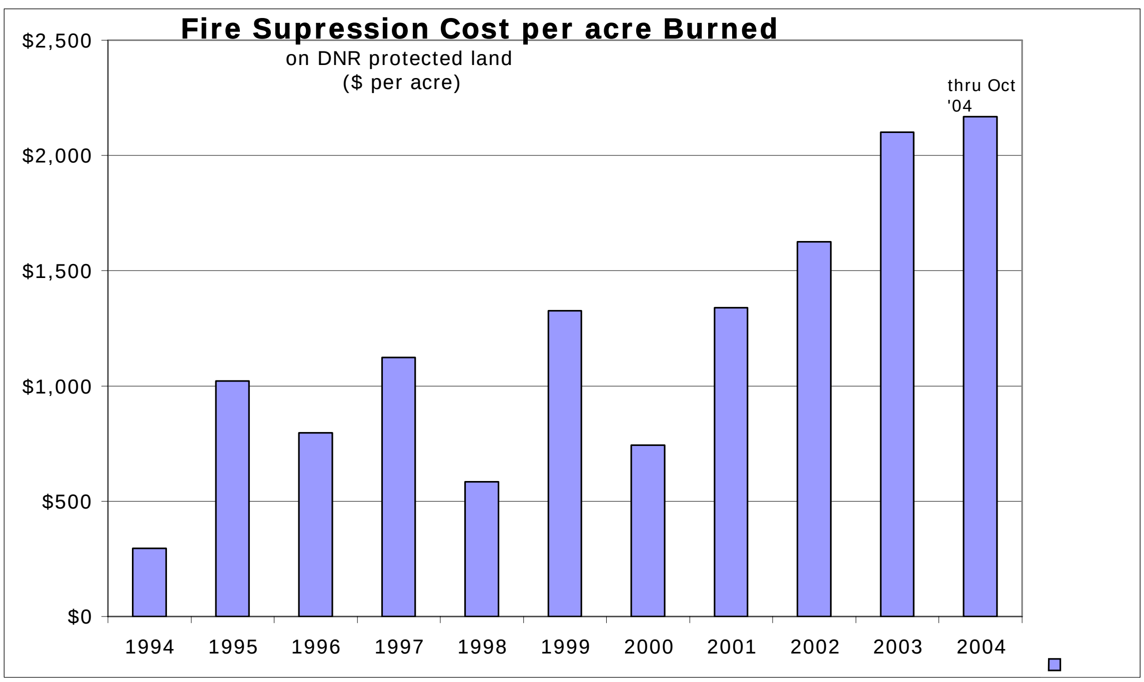

Figure DP10.4: Fire suppression cost per acre DNR 1994-2004.

Table DP10.2: Okanogan-Wenatchee National Forest average fire suppression costs by size class 1990-2002.

Okanogan-Wenatchee Fires 1990 – 2002			
Size Class	**Suppression Costs**	**Total Acres Burned**	**Average Cost per Acre**
A (0-.25 acres)	$1,359,382	188	$7,231
B (.26-9.9 acres)	$4,769,332	948	$5,031
C (10-99.9 acres)	$8,484,542	2,662	$3,187
D (100-299.9 acres)	$6,736,500	3,379	$1,994
E (300-2999.9 acres)	$27,646,681	10,530	$2,626
F (3000-4999.9 acres)	$27,767,956	28,419	$977
G (5000+ acres)	$100,474,867	280,450	$358

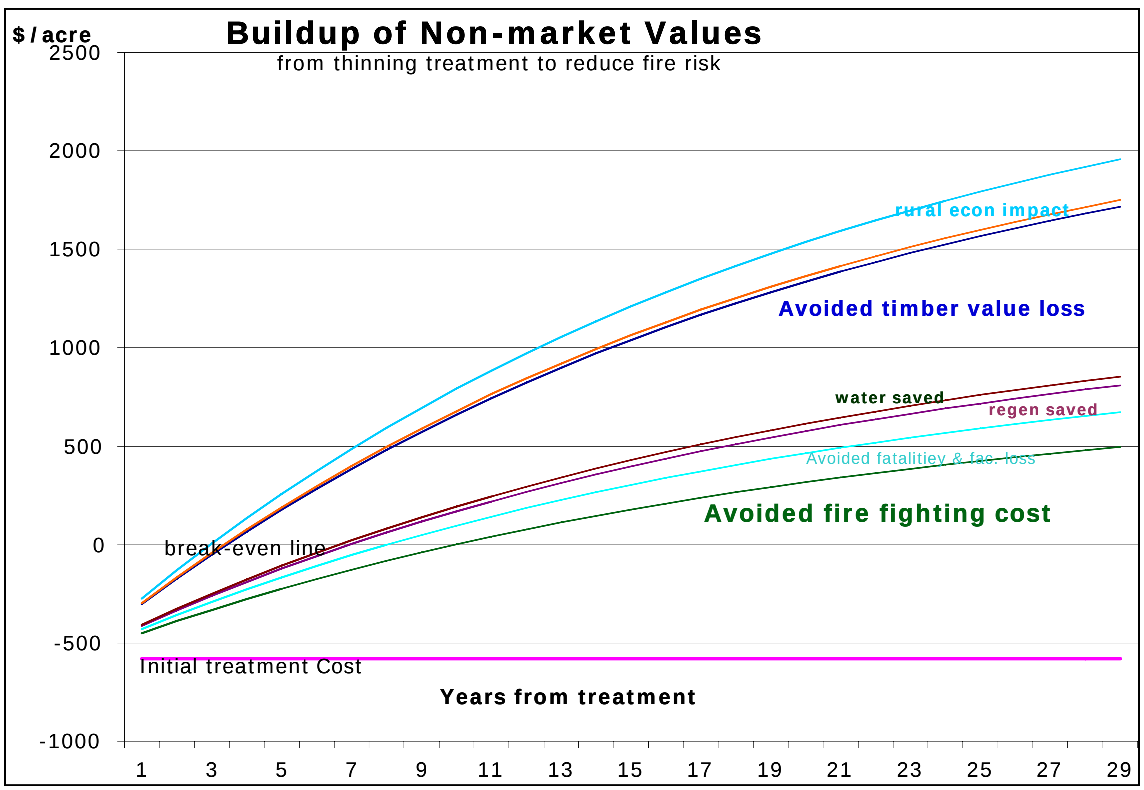

Figure DP10.4: Build up of non-market values assuming a present value of avoided fire fighting cost of $481/acre.

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