



**GETTING BURNED:
A TAXPAYER'S GUIDE TO
WILDFIRE SUPPRESSION COSTS**

by Timothy Ingalsbee, Ph.D.

Firefighters United for
Safety, Ethics, & Ecology

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ABOUT FIREFIGHTERS UNITED FOR SAFETY, ETHICS, AND ECOLOGY (FUSEE):

FUSEE (pronounced FEW-zee) is a national nonprofit organization founded in 2004 that is dedicated to public education and policy advocacy to promote safe, ethical, and ecological fire management. FUSEE members include current and former wildland firefighters, other fire management workers, fire researchers and educators, forest conservationists, rural homeowners, and other interested citizens. A "fusee" is a quick-igniting, handheld torch used by firefighters to secure firelines, create safety zones, reduce hazardous fuel loads, and restore fire-adapted ecosystems. FUSEE informs, inspires, and empowers firefighters and their citizen supporters to become *torchbearers for a new paradigm in fire management*.

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TABLE OF CONTENTS

Executive Summary	3
Part One ~ Introduction: Big Fires=Bigger Costs	5
Soaring Suppression Costs Are Consuming Agency Budgets	6
Fighting Large Wildfires Costs The Most Money	8
Part Two ~ Socioenvironmental Cost Factors: Fuels, Homes, And Climate Change	10
Fuels Accumulation	10
WUI Protection Costs	11
Climate Change	13
Part Three ~ Institutional Cost Factors: Perverse Budgetary Incentives, Private Contract Firefighting, And Federal-State Cost-Share Agreements	14
Congressional Blank Check For Suppression	14
Private Firefighting Contractors	15
Federal-State Cost-Share Agreements	17
Part Four ~ Operational Cost Factors: External Pressures, Managerial Accountability and Risk-Aversion, Wildfire Management Strategy And Tactics	19
Human Factors	19
External Political/Cultural Factors	19
Internal Factors: Leadership Accountability And Risk-Aversion	21
Agency Bias For Suppression And Lack Of Accountability For Reducing Costs	21
Lack Of Incentives For Fire Use And “Risk-Adverse” Managers	22
Part Five ~ Lessons Learned, Looking to the Future	24
Summary	24
Conclusion: Controlling Suppression Costs	29
Post-Script: The Cohesive Strategy For Wildfire Management	33
Bibliography	35
Endnotes	40

EXECUTIVE SUMMARY

Wildfire suppression costs are soaring to over one billion tax dollars per year. This is causing a fiscal crisis in the Forest Service which has exceeded its suppression budget almost every year for the last 20 years. The agency now spends nearly half of its total appropriated budget on firefighting, and has been forced to transfer billions of dollars away from several non-fire land management programs to pay for suppression. Recent legislative changes to suppression funding (e.g. the FLAME fund) may provide better accounting for suppression costs, but do not impose firm budgetary limits on suppression spending, nor absolutely prevent continued transfers of funds from other management programs to pay for firefighting.

Part of the reason suppression costs are rising is because wildfire activity is increasing, especially the frequency of large-scale wildfires. Large fires account for less than 2% of all wildfires but consume 94% of total suppression costs. Despite huge increases in money, resources, and personnel being devoted to fire suppression, the number of burned acres continues to increase. While currently 6-8 million acres defines a “bad” fire season, experts predict an average 10-12 million acres will burn annually in the near future primarily under the impact of global warming.

Suppression costs are increasing due to several reasons that can be categorized according to socioenvironmental, institutional, and operational factors. The most popularly cited reasons for rising suppression costs are the socioenvironmental factors of excess fuels accumulations caused in part from past fire suppression, expansion of housing development in the wildland/urban interface (WUI), and climate change from global warming fueled primarily by human-caused fossil fuel burning. Of these three, climate change is the dominant factor affecting increased wildfire activity and fire size due to its effect on weather and vegetation and length of wildfire season.

Next to total fire size, the presence of private property or human structures in the vicinity of wildfires is the other factor most affecting the rise in suppression costs. Fire managers speculate that up to half of total suppression expenditures are related to private property protection in the WUI. Over 44 million homes in the U.S. are currently located in fire-prone WUI areas, but the Forest Service predicts a 40% increase in new homes in the WUI by 2030 which some studies estimate could raise annual suppression costs from \$2 to 4 billion.

Among the institutional drivers of rising suppression costs are the budgetary structure for the Forest Service that authorized deficit spending for suppression operations. This has nurtured an “open checkbook” attitude among managers to order whatever resources or actions they desire regardless of cost, and this inhibits efforts to contain costs. Worse, some critics argue that the budget system with authorized deficit spending has set up a system of “perverse incentives” for agencies to rely on reactive fire suppression actions rather than proactive fuels reduction or ecosystem restoration projects since these must be funded by fixed budgets, and impose more legal requirements (e.g. environmental analysis and public involvement) in comparison to firefighting actions which have almost no budgetary limits, legal constraints, or public oversight due to their “emergency” status.

Another institutional driver of rising suppression costs is the growing use of private contractors to provide firefighting crews, aircraft, vehicles, supplies and services. Private contractors typically account for over half of total expenditures on large wildfire suppression incidents, with some suppression resources costing several thousands of dollars per hour to use. The privatization of firefighting has been driven largely by political and ideological interests seeking to shrink the size of the federal workforce, and has been

sustained by the promise that private businesses would provide cheaper, better, more efficient service. However, private contractors not only cost more than public agency crews, but there have been concerns about the inferior work performance of some contractors whose lack of productivity (e.g. fireline construction) also raises suppression costs.

Another institutional factor is the inequity structured into cost-share agreements between the federal and state governments. The federal government usually pays the bulk of suppression expenses on multi-jurisdictional wildfires, even if the major reason a wildfire is being suppressed is to protect private or state lands. Local, county, and state governments receive all of the benefits of new development in the WUI (e.g. increased property taxes, building permits revenue, etc.), but do not pay their full share of wildfire protection costs. The result is that taxpayers across the country are essentially “subsidizing” private development in an expanding WUI by providing free/low-cost fire protection to private property owners. More equity in cost-share agreements would not necessarily reduce suppression costs, but might provide more incentives to local governments to restrict or regulate WUI development in ways that reduce the risk of wildfire damage and therefore reduce the pressure for aggressive suppression on adjacent public lands.

Operational factors are the least-discussed reasons for rising suppression costs, but the human factors influencing the objectives, strategies and tactics managers employ to respond to wildfires have huge cost implications. First, the agency is sensitive to external cultural expectations by the public and political demands by politicians to aggressively fight all wildfires. Expensive suppression resources or actions are sometimes ordered to satisfy agencies’ public relations needs even though conditions on the ground make them unnecessary, inefficient, or ineffective. There is far more pressure placed on managers to prevent wildfire damage than to reduce suppression costs, consequently, there is a general lack of accountability for suppression spending, and numerous reports and recommendations for containing suppression costs have largely been ignored.

Along with external pressures to fight fires, and a lack of accountability for reducing suppression costs, there is a lack of incentives for managers to implement alternatives to aggressive suppression, especially wildland fire use. Managers fear public reaction, personal liability, or professional demerits on their careers if any accidents (e.g. firefighter fatalities, destroyed homes, scorched private lands) were to occur from a wildfire they were managing for resource benefits. These so-called “risk-adverse” managers are actually comfortable with imposing risk on firefighters by exposing them to the inherent health hazards and safety risks of firefighting, and externalizing risk to ecosystems due to the biological effects of fire suppression/exclusion and the potential increased severity of future wildfires. Consequently, many wildfires are unnecessarily or over-aggressively suppressed when they could have been managed at lower risk to firefighters and lower cost to taxpayers.

Of all the factors accounting for rising suppression costs, operational factors have the most potential to immediately reduce suppression costs. Managing wildfires—as opposed to simply “fighting” them—with alternative strategies and tactics that maximize the social and ecological benefits of burning while minimizing their potential adverse effects is far more economically and ecologically rational. A more strategic and selective approach to fire suppression would focus it on frontcountry communities which absolutely cannot tolerate fire, and then implement fire use tactics in backcountry wildlands which generally require more fire. This approach would not necessarily reduce overall taxpayer expenditures since managing wildfires that burn larger and longer will still cost money. But, instead of these being pure “costs” whose only benefit is the avoidance of adverse outcomes, fire management operations that use fire would become more like investments in beneficial community protection, fuels reduction, and ecosystem restoration that enhances long-term community sustainability and land stewardship.

PART ONE

INTRODUCTION:

BIG FIRES=BIGGER COSTS

In 1908 a Congressional legislative rider created the Forest Fires Emergency Act that gave the U.S. Forest Service the authority to engage in deficit spending for fire suppression. The USFS could spend unlimited amounts of tax dollars in the heat of battle, fighting fires without any real fiscal constraint. During the “Big Blowup” of 1910 when 3 million acres burned in the northern Rockies, the fledgling agency exercised this authority when it spent over \$1.1 million attempting to suppress the fires. Today, \$1 million is the average *daily* cost of a typical large fire suppression incident. Federal agencies now spend over \$1 *billion* annually on firefighting while the number of burned acreage continues to grow.

Up until the 1950s, an average 30 to 40 million acres burned annually in the national forests of the West, but there was no sense of “crisis” during this time—American society had other fiscal problems to confront and other wars to fight. Following World War II, the number of acres burned nationwide plummeted to around 3 million acres per year, and that became the new “normal” to most people. The convergence of prolonged cool, moist climatic conditions, a growing federal workforce ready, willing, and able to serve as a firefighting “militia,” and an aggressive road-building program that enabled convoys of firefighters and heavy equipment to be sent into formerly remote wildlands all helped to keep the number and size of wildfires unnaturally low. The agency had plenty of incentive to aggressively attack all wildfires and put them out as quickly and cheaply as possible in the post-War period because its budget appropriations centered on its commercial logging program, and wildfires were perceived as threats to the timber resource and the agency’s revenue.

Then a sudden shift occurred in the late 1980s beginning with the “Siege of ‘87” in California and Oregon, followed the next year by the massive Yellowstone Fires. These large-scale, long-duration wildfire events marked the beginning of significant changes in the size of individual wildfires, the total number of acres burned, and the costs of fighting fires.¹ The 1994 fire season shocked fire management agencies with another huge increase in the costs of firefighting, along with the ultimate cost of 34 firefighters killed in action. A full-blown crisis over the risks, costs, and impacts of wildfire suppression had arrived.

Beginning with the 1995 Federal Wildland Fire Management Policy and Program Review, a number of studies, reports, and policy initiatives were offered to both improve firefighter safety and reduce the rising costs of fire suppression. There have been a multitude of other reports over the last 15 years attempting to understand why the size of wildfires and number of acres burned continues to increase, and above all, trying to figure out why the costs of suppression continue to rise even during years when wildfire activity temporarily declines. Each year of high suppression costs prompts a new series of cost reviews, with new rules and guidelines intended to contain or reduce suppression costs, but most of these reports and recommendations are overlooked, ignored, or forgotten, only to be repeated with each “bad” fire season in a continuing “boom and bust” cycle of Congressional funding.² Despite spending billions of tax dollars and deploying thousands of firefighters, for the foreseeable future we will see the size and duration of wildfires continue to grow along with the costs and impacts of fire suppression.

This report will review some of the major social and environmental factors causing fire suppression costs to keep rising. Some of the lesser-known and often overlooked explanations such as the “human

dimensions” of wildfire management will be highlighted. The paper will conclude with recommendations for changing the ways we manage wildfires, beginning with a paradigm shift in the way we relate to forest fires in general and a strategic shift in the specific ways we plan and prepare for their annual appearance.

Most official reports and analyses of the causes of suppression cost increases can be grouped into three general categories. Part Two will discuss the most popular category of socioenvironmental explanations: 1) excess fuels accumulations from past fire exclusion policies and fire suppression actions; 2) the growth and pattern of housing development in the wildland/urban interface (WUI); and 3) climate change that is causing wildfires to burn larger and fire seasons to last longer.

Part Three discusses another category of explanations that focus on institutional factors related to budgets and financing for wildfire suppression: the “perverse incentives” for wildfire suppression created by the budgetary structure of the Forest Service, giving it a Congressional “blank check” for emergency firefighting, and enabling it to “borrow” funds from other land management programs to fund firefighting. Additionally, there are unequal cost-share agreements between the federal and state governments for firefighting on multi-jurisdictional wildfires. Another perverse incentive flows from the growing use of expensive private contractors to supply crews, equipment, and supplies that is fast turning fire suppression from a public service into a private, for-profit business.

Part Four presents the least discussed set of explanations: the human dimensions of managing wildfires. These human dimensions involve four compounding factors that have huge implications for the size of fires and the costs to manage them. First, unrealistic expectations of the public, politicians, and the newsmedia assume that all wildfires can and should be aggressively fought. Second, the lack of agency accountability diminishes options for limiting suppression spending. Third, risk-adverse managers face no negative consequences for engaging in high-cost suppression actions and also have few positive incentives for choosing alternative “fire use” strategies that could contain costs. Fourth, the operational strategies and tactics selected by fire managers help determine the costs of suppression. This paper will briefly review all of these explanations while emphasizing the issues that rarely enter public or policy debates.

Soaring Suppression Costs are Consuming Agency Budgets

Before investigating some of the specific causes underlying the rising costs of fire suppression, it is worth examining the scope of the problem to understand how firefighting is creating a real fiscal crisis in the Forest Service. Different reports have come up with different dollar amounts, but the overall trend is the same: suppression costs are soaring both in actual dollar amounts and as a portion of the Forest Service’s total budget.

Beginning in the extreme wildfire seasons of the late 1980s, Forest Service suppression costs grew to an average of \$300 million per year.⁵ From 1995 to 1999, costs rose to \$500 million annually, then from 2000 onward, they averaged over \$1 billion annually. In 2000 suppression costs broke a record by spending \$1.3 billion, then this record was broken again in 2002 with \$1.6 billion spent. Over \$500 million that year was spent on just four wildfires as four states had the largest wildfires in their states’ recent history.⁴ The 2006 fire season had 20 wildfires that cost a combined \$500 million out of another \$1.6 billion total spent that year.⁵ Then the 2007 fire season broke all previous records with a whopping \$1.8 billion spent fighting fires.

Firefighting costs are closely but not entirely related to the number of acres burned, and wildfire activity is highly variable both on an annual and regional basis. However, the clear trend is a rapidly increasing cost in fire suppression, even when wildfire activity temporarily declines. In Fiscal Year 1970, fire management expenditures amounted to \$61 million but by 1994 they rose to almost \$1 billion. Indeed, a total of \$11.8 billion were spent on fire-related programs over this 25 year period.⁶ According to an in-depth analysis by NAPA,⁷ the average costs of wildfire-related expenditures (includes both suppression and pre-suppression activities) were the following:

Years	Annual Costs
1970s	\$420 million
1980s	\$460 million
1990s	\$700 million
2000s	\$1.4 billion

In addition to a rapid growth in total expenditures, firefighting has taken a bigger portion of the Forest Service’s overall budget. For example, in FY1991 fire management activities (the largest component being fire suppression) was a mere 13% of the Forest Service’s total budget, but in FY2009 that had grown to 48%.⁸ From 1996-2000, the average annual appropriation for fire management programs was \$1.2 billion, but from 2001-2007 this grew to \$3.1 billion appropriated each year for fire management activities, with over 70% of this amount going to the Forest Service.⁹ Despite these huge and growing appropriations, firefighting expenses have caused the Forest Service to exceed its budget for suppression nearly every year over the last decade.¹⁰ With nearly half of the agency’s budget consumed with firefighting-related activities, this is causing some critics to label the Forest Service as the “Fire Service” in reference to its apparent transition from a land management to a fire management agency.¹¹

While the ecological effect of increasing wildfire activity is subject to debate, there is no question that the economic costs of fighting fires is causing a fiscal crisis in federal land management agencies, particularly the Forest Service. So what are the reasons fueling the escalation of firefighting expenses? The rest of this report reviews the major factors underlying the growing costs of firefighting.

Fighting Large Wildfires Costs the Most Money

One of the most direct reasons for escalating suppression expenditures is that wildfire activity is increasing in terms of the size of individual wildfire incidents and the annual number of total acres burned nationwide.¹² Forest Service economists have determined that total suppression expenditures are strongly correlated with total acreage burned; consequently, large annual costs are associated with large wildfire events and long fire seasons.¹³

The reasons why wildfire acres are going up will be examined in more detail below, but the issue is more complex than the simplistic quantitative statistics of “acres burned” and “suppression costs” can convey. First, the vast majority of both acres burned and dollars spent result from just a few very big fires. From 1980-2002, 98.6% of all fires were successfully contained at less than 300 acres in size, and all of these fires used only 6.2% of total suppression expenditures. However, the remaining 1.4% of the wildfires consumed 93.8% of all suppression dollars!¹⁴ This kind of extreme disparity between fire size and suppression costs were found in individual fire seasons, too. For example, in 2006, the 20 biggest wildfires accounted for 11.2% of the nearly 10 million acres that were nationwide, but they cost nearly 30% of the \$1.5 billion expended for firefighting by the USFS.¹⁵ In 1999 this disparity was even more extreme when

the Forest Service spent over 30% of its total appropriated suppression budget on just two lightning-caused wilderness fires in California. In short, it is the largest 2% of all wildfires that are the real budget busters consuming vast amounts of tax dollars in apparent futility as these wildfires grow to great size despite all that is spent on suppression efforts.

This connection between wildfire size and firefighting cost is nothing new—that is one of the prime reasons the Forest Service continues its de facto “10 am policy” of aggressive initial attack on nearly every wildfire. Keeping fires small is the principal way the agency attempts to minimize suppression costs, and total cost is how suppression “efficiency” is defined.¹⁶ Yet, this focus on minimizing short-term suppression costs ignores other long-term economic and ecological issues that should be considered. For one thing, acres burned and dollars spent are clear, unambiguous quantitative measures for assessing the economic efficiency of fire management actions, but this measure is flawed because it assumes that each dollar spent or acres “lost” are compensated by dollars and acres “saved” from burning and firefighting outside the given wildfire perimeter. Spending huge amounts of tax dollars attempting to suppress a large wildfire is thus justified by the assumption that if the fire had not been fought, both the wildfire and the economic impact of destroyed resource values would have been even larger. This rationale can lead to a “siege mentality” on large wildfires that consumes more and more money trying to control wildfire in conditions that defy human control.¹⁷



Firefighters' health and safety are put at risk when they are ordered to aggressively fight wildfires during conditions that make suppression inefficient, ineffective, or impossible.

This type of thinking simply ignores fire ecology principles and the multiple benefits of burning for many ecosystems. A more ecologically-based assessment might reveal that alternative “fire use” strategies or tactics could gain more of these benefits of burning while avoiding the expenses of “fighting” the fire. If, in fact, overall resource values are actually enhanced by the effects of fire, then this essentially negates the rationale used to justify expensive suppression efforts—there is no “saving” of unburned resource values, only counterproductive “spending” of suppression dollars.

Firefighting is arguably the most expensive kind of management action on a per-acre basis than anything else the agency does (e.g. logging, road-building, etc.), and this is especially true compared to alternative fire management actions such as wildland fire use. For example, the Forest Service determined that over a 20 year period it cost an average \$582 per acre for suppression actions, but only \$51 per acre for fire use actions.¹⁸ But averaging costs per acre obscures the fact that firefighters typically only work on the outermost edges of a wildfire, so if a wildfire gets very big, the proportion of acres where suppression action occur gets smaller compared to the total number of burned acres in the large interior of wildfires where no actions are taken. When suppression acres are averaged across the total area of a wildfire, this causes the cost-per-acre of suppression to go down, especially on large fires.¹⁹ This economic effect is used by some of the agency’s defenders who counter that suppression costs are not “spiraling out of control” because the trend for average costs-per-acre is not increasing.²⁰

The reduction in average cost-per-acre, however, is rendered meaningless by the actual increase in costs when managers select a full suppression strategy aiming for complete perimeter control. Whereas a full suppression effort requires managers to keep ordering more crews and equipment as the wildfire perimeter grows, thereby raising total costs, if managers select a fire use strategy, then a relatively small force is capable of monitoring and managing a large blaze without the equivalent need to keep increasing the number of crews and equipment as the fire grows. Thus, large fires offer the potential to manage them relatively inexpensively with an economy of scale if alternatives to total suppression and full perimeter control are employed.²¹ This brings up one of the issues rarely addressed by the numerous reports over the years that have examined the factors raising suppression costs—the fact that fire management strategies and tactics have the most direct impact on suppression costs—an issue that will be discussed later in this paper.

In sum, at its most simplistic statistical level, the reason suppression costs are rising is that individual wildfire sizes and the total number of burned acres are rising. The question now must be asked, why are wildfires and acres burned growing despite billions of tax dollars and thousands of firefighters used to fight them? The three most common explanations for the current trend in larger wildfires and higher suppression costs are: 1) excessive fuel loads resulting from past fire suppression actions and fire exclusion policies; 2) the continuing expansion of new housing development adjacent to fire-prone public lands, called the wildland/urban interface (WUI); and 3) prolonged droughts, increased storm activity (e.g. lightning, high winds), and more frequent severe fire weather episodes (e.g. higher temperatures, lower humidities) caused by ongoing climate change.²² Although these three socioenvironmental factors are interconnected, it is worth examining each of these phenomena individually to understand their specific effects on wildfire suppression costs.

PART TWO

SOCIOENVIRONMENTAL COST FACTORS: FUELS, HOMES, AND CLIMATE CHANGE

Fuels Accumulation

Coinciding with the rise of wildfire activity in the late 1980s and the decline of commercial logging in the early 1990s, the Forest Service announced that it had a “forest health crisis.” Millions of acres of public lands were deemed to be at high to moderate risk of “catastrophic wildfire” because of hazardous fuels accumulations, primarily dense thickets of small-diameter understory trees, saplings, and shrubs along with larger-diameter diseased, dying or dead overstory trees. In a case of extreme irony, the Forest Service argued that so-called “past” fire suppression allowed this live vegetation and dead fuel to accumulate, and these excessive fuel loads were causing the sudden increase in large-scale high-intensity wildfires. If past fires had been allowed to burn instead of being suppressed, then forests would have been naturally thinned, their fuel loads reduced, and theoretically wildfires would be smaller and less costly to manage.

This fire suppression-fuels accumulation argument has some merit in certain ecosystems such as low-elevation ponderosa pine forests that have a low-severity/frequent fire regime, and firefighting has caused these ecosystems to miss some burning opportunities. However, this argument was often overgeneralized to inappropriately include ecosystems such as high-elevation lodgepole pine forests or chaparral shrublands that naturally have high-severity/infrequent fire regimes, so past suppression actions do not have the same impact on their fuels loads or fire severity.

Additionally, the Forest Service aggressively pitched “mechanical fuels reduction treatments” as its preferred cure for the forest health crisis. This often involved commercial extraction of large-diameter trees along with removal of non-commodity small-diameter trees and shrubs. This caused some forest conservationists to charge that the agency was opportunistically using the forest health/fuel hazard “crisis” as a smokescreen to propose timber sales amidst legal constraints and public opposition to continued commercial logging. Consequently, although excess fuels accumulations are part of the reason that wildfire size and severity is increasing in some areas, the argument was over-generalized and sometimes exaggerated, and does not fully explain why suppression costs are rising.

The costs and impacts of various fuels reduction “treatments” are beyond the scope of this paper, but in general, the estimated cost of reducing fuels across millions of acres of public wildlands would be several *tens of billions* of dollars just for the initial entry treatments.²³ Estimates have ranged from 39 to 190 million or more acres on public lands have missed fire cycles due to past suppression efforts, and require some fuels management. Treatment costs range widely, too; for example, as low as \$45 or less per acre for prescribed burning to \$1,700 or more per acre for mechanical treatments.²⁴ Moreover, in WUI areas, per-acre fuels reduction costs can be higher—one study determined that they were 139% higher than in non-WUI areas.²⁵ This huge expenditure is not a realistic expectation given the current fiscal crisis of federal and state governments. Moreover, it must be understood that treated vegetation and fuels will regrow and accumulate, so fuels reduction projects will have to be maintained at least once every 10 years in perpetuity, thus requiring future expenditures.

A sobering fact is that fuels reduction efforts are not keeping pace either with the rate of natural fuels accumulation or the scale of wildfire activity. Moreover, each “successful” suppression incident needs to account not only for its direct costs, but also the deferred costs of future fuels reduction projects and/or fire suppression actions in adjacent areas that would have burned if not for firefighting efforts. Thus, unless and until fuels management objectives are integrated in wildfire management operations, both fire suppression and fuels reduction costs will continue to rise in the future.

WUI Protection Costs

Another widely recognized contributor to rising suppression costs is the expense of protecting homes and structures in the wildland/urban interface zone (WUI). The percentage of private land and presence of private homes is second only to total fire size as a factor causing increased suppression expenditures.²⁶ Despite the mandate in the Federal Wildland Fire Policy to value private property and natural/cultural resources equally, the fact of the matter is that managers put structural protection in the WUI second only to the protection of human life as their highest priority in determining suppression strategies.²⁷ Significant federal firefighting resources are used to protect private property, and at times the cost of using these suppression resources can be greater than the monetary values of the structures being protected. But public expectations and political pressures compel fire managers to do whatever they can to save homes from wildfire destruction because, in the minds of managers, the negative publicity of burned homes far outweighs the negative effects of high suppression costs.²⁸

Focusing suppression resources on the WUI removes options from firefighters to locate themselves in the best places for taking the safest, most efficient and effective actions. For example, fire managers prefer to use geographic features such as existing forest roads, ridges, or rivers to anchor firelines, but if homes and other private structures are located between these features and a wildfire, then managers are compelled to construct new firelines near the WUI, often in places of difficult terrain or fuel conditions, in order to attempt stopping wildfire spread before it reaches those structures.²⁹ As a matter of safety, efficiency, and effectiveness, firefighters must be able to choose the best ground they can make a stand on, so to place them near vulnerable and often indefensible structures is definitely raising the costs and the ultimate stakes of wildfire suppression.

It is more often the case that instead of placing firefighters directly within or adjacent to the WUI, they are sent to aggressively suppress wildfires located several miles away to prevent fire from spreading anywhere near the WUI. These suppression actions are more costly compared to fire use strategies that might let wildfire burn more acres for either ecological benefits or cost savings—an option that is too often rejected out of fear that wildfire will spread to the WUI. In a major audit of large fire suppression expenses, the USDA OIG determined that in 87% of the fires it audited, private property protection was the primary rationale for firefighting efforts.³⁰ In sum, the public/political pressure to prioritize property protection over other natural and cultural resource values is definitely influencing suppression strategies, making fire and fuels management both more costly and complex.³¹

Numerous studies have come up with different figures for the size and number of homes in the WUI, and the fact is that there is no agreed spatial definition of the “WUI zone,” but all studies do agree that the WUI is extensive and is rapidly expanding. For example, Forest Service researchers estimate that 44 million homes in the continental U.S. are located in the WUI³² with approximately 8.4 million of these homes being built during the 1990s.³³ NAPA predicts that by 2030 there will be a 40% increase in the number of homes in the WUI compared to 2001 levels.³⁴ According to Headwaters Economics, only 14%

of available private land located in the WUI is developed, leaving a huge potential for growth in the remaining 86% of the acreage.³⁵

While the current economic recession may have the effect of slowing the rate of new home construction in the WUI, the majority of this new construction is going to second homes or vacation homes of the wealthy who, in general, are still able to move forward on construction plans. Relatedly, some argue that the WUI zone should be expanded to include not only houses, but important urban “infrastructure” such as powerlines, communication towers, even municipal watersheds. This expands the WUI zone to cover an even greater portion of the landscape. Thus, the growing size and scale of the WUI is going to continue being a driver of higher suppression costs unless and until new strategies are created for protecting communities and managing fire and fuels near them.



Pressures to protect private property at all costs results in huge taxpayer expenditures for suppression operations that sometimes cost more than the value of the structures being protected.

Several studies have also attempted to precisely calculate the influence of the WUI on suppression costs. In 1994, the USFS estimated that approximately 1/3 of its suppression expenditures that year went towards protection of the WUI. A recent GAO study reported that Forest Service managers estimated that 50-95% of the total firefighting costs on National Forest lands was related to WUI protection.³⁶ When large wildfires burn near homes, this can increase suppression costs by an average \$1 million for each additional 125 homes—and the definition of “nearness” includes homes up to 20 miles away from wildfires.³⁷ A study that attempted to quantify the extra cost of suppressing WUI wildfires came to the surprising conclusion that there was no relationship between housing proximity or density and suppression costs, only fire size was a significant variable, however, they explained that this result could have happened because fire managers assumed all wildfires would threaten the WUI, regardless of their proximity to actual houses, and thus the costs of suppressing those more remote wildfires may have not been captured in their study sample.³⁸

In the rigorous study by Headwaters Economics, they determined that annual WUI protection costs in Montana averaged \$28 million, and that this figure could grow to \$40 million by 2025 if WUI development continues unabated.³⁹ This figure explodes to between \$61 and \$113 million for WUI protection under the

effects of climate change.⁴⁰ Applied nationally, the Headwaters Economics study estimated that firefighting costs for private property protection alone currently range from \$630 million to \$1.2 billion, but a 50% growth in housing development could raise annual suppression costs up to two to four billion dollars.⁴¹

The unfortunate fact is that hundreds of homes and other structures are lost every year to wildfire in spite of firefighters' best efforts and the millions of dollars spent on suppression specifically for property protection. For example, the record-breaking \$1.8 billion spent on suppression in 2007 still could not prevent 5,400 homes from being destroyed by wildfire.⁴² It is unrealistic to assume that firefighters will always be successful in saving structures from wildfires, but it is equally unrealistic to expect that they should always try to protect structures regardless of the risks to themselves or the economic costs of their efforts. The whole issue of WUI protection is controversial not only because of its overall effect on suppression costs, but because it also involves issues of social equity between those who pay the costs and those who benefit from suppression actions or fuels projects in the WUI.⁴³ The continuing expansion of the WUI and the societal expectations to protect private property and homes at any and all costs will continue to be another major cost driver in wildfire suppression.

Climate Change

Fuels accumulation and the growth of the WUI have been a fairly steady development over the last century, particularly after WWII when mechanized fire suppression was more successful in excluding fire from the landscape, and housing development exploded in fire-prone wildlands. But a major shift began with the "Siege of '87": a significant increase in the number and size of large wildfires. The decades-long growth of fuel loads and rural subdivisions did not explain this sudden shift, but climate change did. Global warming and climate change are affecting all regions of the planet in several different ways, but in many areas of the West, climate change is causing earlier snowmelts in spring, later rains in fall, lighter snows in winter, and warmer, drier temperatures in summer. All of these changes in weather have combined to create a lengthier time that fuels are available to burn, resulting in longer fire seasons, and more extreme fire behavior. Ongoing climate change is also predicted to cause an increase in severe fire weather and extreme storm events that will bring both abundant lightning and high winds to start and spread wildfires. Indeed, the Forest Service's 2009 Quadrennial Fire Review now predicts that the effects of global warming and climate change will result in 10-12 million acres burning annually in the U.S.⁴⁴

Predictions about future suppression spending related to climate change offer dire prospects for containing costs. One study predicted that just a one-degree Fahrenheit increase in average spring/summer temperature would increase suppression costs from \$28 to \$84 million per year in Montana alone.⁴⁵ Furthermore, that same one-degree rise in average temperature would lead to a 305% increase in area burned by wildfires, and a 107% increase in suppression costs to protect the WUI.⁴⁶ This translates into a range between \$61 million to \$113 million dollars annual increase in suppression expenditures.⁴⁷ Few studies predict climate change to stop at a one degree rise in temperature; thus, these figures are most likely conservative estimates of future annual increases in suppression costs.

Climate change is among the top three most-cited "socioenvironmental" causes for rising suppression costs, however, it is beyond the scope of this paper to discuss in detail all of the adverse effects of climate change on wildfire. Instead, discussion will move to some of the institutional and operational causes of rising suppression costs, factors that are much less discussed by agencies, politicians, and the newsmedia.

PART THREE

INSTITUTIONAL COST FACTORS: PERVERSE INCENTIVES, PRIVATE CONTRACTORS, AND COST-SHARE AGREEMENTS

Congressional Blank Check for Suppression

Several critics have focused on the funding system that Congress has set up for emergency wildfire suppression, charging that it has nurtured a “blank check” or “open checkbook” attitude among federal fire managers, and this institutional arrangement is a major driver of the rising costs of suppression.⁴⁸ This attitude began with the Forest Fires Emergency Act in 1908 that was repealed in 1978 when the Forest Service changed its philosophy from fire control to “fire management,” and Congress switched to a system of providing annual appropriations for suppression (around \$110 to \$125 million annually).⁴⁹ Back then, commercial timber extraction was the main focus of the agency, most wildfires were still easily controllable, and the agency rarely exceeded its appropriated suppression budget. When an occasional large fire season exceeded those funds, the Forest Service “borrowed” funds from its reforestation fund, and sought extra or supplemental appropriations from Congress to pay back the account later.

But then a surge in wildfire activity occurred in the late 1980s, and the Forest Service began to rack up an accumulating deficit that was rapidly depleting its reforestation fund. Congress tripled the agency’s appropriation for fire suppression (averaging over \$300 million annually) in the 1990s, but suppression costs continued to rise, busting the agency’s suppression budget. Indeed, the Forest Service has exceeded its suppression account nearly every year since 1990, causing the agency to transfer hundreds of millions of dollars from all kinds of management programs and accounts to pay for firefighting.⁵⁰ For example, from 1999 to 2003, the Forest Service transferred over \$2.2 billion to fund firefighting expenses.⁵¹

Ironically, some of these transfers came from programs such as hazardous fuels reduction and firefighter training that theoretically would reduce suppression costs over the long-term.⁵² For example, in 2003, approximately 120,000 acres of National Forest lands that had scheduled fuels reduction projects were left untreated because these project funds were transferred to pay for firefighting expenses.⁵³ Transfers have come from other non-fire management programs too, such as recreation, wildlife habitat improvement, and land acquisition accounts. Firefighting is quickly becoming the dominant mission in the Forest Service, consuming nearly half of its total annual appropriated budget.

Congress used to repay almost 100% of these budget transfers through supplemental appropriations, but these have fallen short during the huge billion-dollar-plus fire seasons of the last decade. This has put many land management programs and responsibilities at risk, leading to an unusual coalition of forest conservation organizations, resource extraction interests, and county governments to lobby Congress to change the institutional mechanisms for funding fire suppression so it will stop the continual transfer of funds from unrelated land management programs. In 2009, Congress passed the FLAME Act as part of the FY2010 Interior Appropriations Act, and this set up a special multi-million dollar reserve account to pay for suppression costs that exceed normal appropriations. This is a positive step towards honest budgeting and fiscal accountability, but it does nothing to create incentives for containing suppression costs, nor will it prevent future budget transfers or supplemental appropriations if and when firefighting costs exceed the FLAME fund. Given predictions of ever-greater number of large wildfires and acres

burned in the near future, it should be expected that the FLAME fund will eventually become exhausted and the fiscal crisis of suppression spending will continue unabated.

The truth is that there is essentially no budgetary or fiscal constraint limiting what the agency can spend to fight fires as long as wildfire suppression trumps all other economic or ecological concerns. Knowing that Congress will never refuse to pay for the “war” on wildfire, there is little motivation among managers to contain suppression costs or utilize economic efficiency.⁵⁴ There is a clear disincentive to invest in proactive fire management activities like prescribed burning because these projects must be paid through normal appropriations which are shrinking as part of the wider fiscal crisis of the federal government.⁵⁵ On the contrary, some critics charge that the system of deficit spending, budget borrowing, and Congressional reimbursements has created a system of “perverse incentives” for the Forest Service to suppress nearly every wildfire.⁵⁶ Bureaucratic inertia continues to reward these perverse incentives even in the face of changing scientific understandings and social values that make alternative fire use strategies ecologically or economically wiser, particularly for backcountry wildfires in fire-dependent ecosystems. Unless and until this institutional bias towards unquestioned fiscal support for firefighting is challenged and changed, the “open checkbook” attitude will continue to be rewarded and suppression costs will continue to climb.

Private Firefighting Contractors

Ever since the Reagan-Bush Administration there has been a concerted effort to privatize more aspects and elements of wildland firefighting. This privatization of firefighting has been driven largely by conservative Republican ideology’s professed desire to shrink the size of government, but it has been sustained by both political parties based on the claims that private businesses can perform services cheaper and more efficiently than government agencies, thus reducing suppression costs over time. According to this theory, instead of hiring government crews that have to be paid, housed, and equipped for the whole fire season, private contract firefighters only need to be paid while they are actually fighting a wildfire, and when the fire is out their contract and pay is over. Thus, one of the main arguments for downsizing the federal firefighting workforce and divesting federal agencies of their own firefighting vehicles, aircraft, and equipment over the last 20 years was the promise that privatization would reduce suppression costs.⁵⁷

Unfortunately, that false promise has led to its exact opposite: suppression costs have increased with the extensive and growing use of private contractors. A new “fire industrial complex” has developed that actually promotes more spending for suppression due to the premium prices that contractors get for their services.⁵⁸ Contractors now represent the major cost center in firefighting, accounting for an average 56% of suppression costs on large wildfires.⁵⁹ During the \$1.6 billion dollar 2002 fire season, two-thirds of suppression costs on large wildfires went to contractors.⁶⁰ Equipment such as bulldozers, low-boys, and water tenders used in firefighting are provided by private contractors who can charge high prices because government agencies do not own many of these items. Contractors are used mostly on large wildfires where over the long duration of these fires the cumulative daily rental costs for some of these vehicles or equipment can exceed the purchase price of these items.⁶¹

Private contract aircraft are typically one of the highest costs of suppression, making up nearly a third of all expenses on a large wildfire.⁶² A single airtanker costs up to \$14,000 a day to keep on standby, and up to \$4,200 per hour for flight time, while the Type I heavy-duty helicopters can cost \$32,000 a day for standby status plus \$6,300 per hour for flight time.⁶³ Aircraft use on large wildfires can cost over a quarter million dollars in a single day!



The privatization of firefighting has led to replacing low-cost public agency labor with high-priced private contractor aircraft, vehicles, and equipment, such as this tank-like terrorch.

Private contract firefighting crews are generally more costly per hour or per unit than agency resources.⁶⁴ Studies from the Pacific Northwest, for example, have shown that federal firefighting crews cost approximately 70% that of a private contract crew.⁶⁵ Assuming a 14-hour workday on wildfires, and continuous work throughout the fire season, agency crews cost on average \$5,539 per day compared to private crews that cost \$7,791 per day.⁶⁶ This cost advantage is reduced if agency crews are not kept busy doing other management projects when fires are not burning, or if higher pay grade employees are used in fire crews. But in addition to cost differences, there is a perceived difference in quality of the work output by contract crews. A qualitative study interviewing IMTs revealed that, in the perspective of federal fire managers, many private firefighting contractors are poorly trained, unqualified, and unmotivated, and thus, their work is generally substandard or inferior compared to public agency crews.⁶⁷ For example, the GAO determined that one of the reasons the 2002 Biscuit Fire in Oregon grew so large and cost so much was due to the poor quality and performance of contractors.⁶⁸ At \$155 million, the lightning-caused Biscuit fire that burned almost entirely in designated wilderness and inventoried roadless areas was likely the most expensive suppression effort in human history! Thus, the higher prices and lower quality of contract crews compared to government crews also contributes to the increasing cost of fire suppression.

Private contractors generally require more oversight, but there is a shortage of contract officers in the Forest Service to provide fiscal and operational oversight.⁶⁹ Indeed, federal agencies are not sufficiently staffed or trained to manage the thousands of private contract employees and equipment that can staff a large, long-duration wildfire.⁷⁰ Sending a contract firefighting crew home for safety violations or poor performance raises transportation costs, requires a new crew to be hired, and the delays in work output prolongs operations which affects total suppression costs. Some contractors have become sophisticated in

working the system to provide overpriced but substandard crews or equipment, and there is a lack of accountability when they fail to perform as promised.⁷¹

Despite the increased costs and decreased performance of contract firefighting resources, there is lots of pressure by Congress and local communities to hire private contractors.⁷² IMT's have disclosed that this political pressure compels agency administrators to insist that agencies hire local contract resources even when they are unnecessary, unqualified, or overly costly.⁷³ The downsizing and aging of the Forest Service workforce to some extent compels the agency to employ private contractors as long as the model of large fire suppression prevails. Thus, the increasing privatization of fire suppression has turned firefighting into a hugely profitable big business, and the Forest Service into a very large contracting business.⁷⁴ This is precisely what previous Administrations and members of Congress intended, and is another major factor in the increasing costs of federal fire suppression.

Federal-State Cost-Share Agreements

Another reason suppression costs are rising is due to the various cost-share agreements between federal agencies and state governments that leaves federal agencies paying most of the bill for fighting multi-jurisdictional wildfires.⁷⁵ This raises equity issues for it is particularly unfair to taxpayers across the nation to pay the bill for costly suppression actions that are taken on federal lands primarily to protect adjacent private property.⁷⁶ The bill not only includes direct firefighting expenses, but also environmental damage to public lands from those suppression actions that degrade the resource values or require expensive rehabilitation and restoration projects to mitigate the damage caused by firefighting. Post-fire rehabilitation projects that occur after a wildfire is contained and controlled are actually charged to the suppression incident, paid for by taxpayers.

Because federal agencies are willing to fight fires on public lands to protect private lands, and have agreed to pay most of the costs of fire suppression, critics argue that this allows private homebuilders, local governments, and the states to evade responsibility or accountability for approving new housing development in fire-prone lands.⁷⁷ Local and state governments receive all of the benefits of suburban/exurban sprawl (e.g. building permit fees, property taxes, etc.) but do not pay the full costs for WUI fire protection--or face the consequences when wildfire disasters strike. In effect, providing public agency wildfire protection for private property owners represents a subsidy and partial incentive for suburban and exurban sprawl into wildlands, exacerbating the issue of high-cost WUI wildfires.

State governments argue that the federal government is responsible for preventing wildfires starting on federal lands from spreading onto private/state lands, and thus federal agencies should pay the majority of the costs of fighting multi-jurisdictional wildfires. State governments are particularly concerned about fuel hazards on federal lands, and are opposed to wildland fire use policies that might increase the risk of fires escaping onto state/private lands or producing more smoke emissions. Yet, there needs to be recognition of the ecological fact that wildfires are inevitable natural processes, and when conditions are right they can and will burn across jurisdictional or property boundaries regardless of human efforts to stop them. Accordingly, those who own property need to assume more financial responsibility for wildfire preparation, and local, county, and state governments who gain economic benefits from private property must pay more of the costs for fire suppression in the WUI.

Greater equity in cost-share agreements would not necessarily reduce suppression spending, but it would reduce federal spending by transferring more of these costs onto state and local governments. If state, county, and local governments are forced to pay more of the costs of private land and WUI fire protection, this might create economic incentives for them to prevent or mitigate new home construction in wildfire-prone lands through zoning regulations, building codes, vegetation management ordinances, and other similar measures. It would also provide a rationale and create new economic incentives for private property owners and local/county/state governments to better prepare rural communities for fire, thereby reducing the need for costly suppression actions.



Private contractors lease aircraft, vehicles, equipment, and crews to federal and state agencies at high prices, such as this 747 Supertanker that costs \$180,000 per day for a minimum 10-day contract.

PART FOUR

OPERATIONAL COST FACTORS: EXTERNAL PRESSURES, MANAGERIAL ACCOUNTABILITY AND RISK-AVERSION, WILDFIRE MANAGEMENT STRATEGY AND TACTICS

Human Factors

The human dimensions of fire management are a long-neglected area of research and policy, and yet their role in suppression costs is critical.⁷⁸ Human factors account for the variation in firefighting costs between different wildfire incidents when all other factors in the fire environment (e.g. fuel loads, weather conditions, terrain, etc.) remain relatively the same. However, unlike the socioenvironmental or institutional factors discussed above, human factors underlying the strategies and tactics for managing wildfires could be the easiest and quickest to change. The human factors contributing to increased suppression spending can be categorized into 1) “external” cultural/political factors, and 2) “internal” operational and motivational factors. These two sets of human factors play critical roles in the decision whether or not to suppress a wildfire in the first place, and if so, what strategy and tactics will be used. Both kinds of decisions greatly affect costs.

External Political/Cultural Factors

The “external” influences on suppression costs come from outside the government agencies, and center on cultural, political, or media expectations that pressure fire managers to opt for aggressive suppression actions instead of alternative modified suppression or fire use strategies.⁷⁹ A century of pro-suppression policies and anti-fire propaganda have created a “Smokey Bear syndrome” in that most of the public expects firefighters to attack all wildfires. There are strong public expectations that wildfires will be suppressed, that firefighters will always be effective in their actions, and that no expense will be spared in their efforts to protect life and property. A study by NASF summed up the essence of this cultural dilemma: “Citizens, politicians, administrators, and the media have no concept of reality.”⁸⁰ In the false belief that firefighters can actually control large wildfires even during severe fire weather conditions, these external influences exert extreme pressure on fire managers to use costly and extraordinary suppression methods even when managers know that these efforts will have no beneficial effect on the wildfire and will likely be an economic waste.

Firefighters have a phrase for these kind of knowingly futile attempts at controlling wildfire: “political shows” or “political smokes.”⁸¹ *Political shows* refer to those cases where politics pressure managers to use suppression resources, strategies, or tactics that they normally would not use, and when they knew it would be ineffective or unnecessary, because of political pressure by local communities, politicians, or the media to go “put out” a wildfire. Examples include the use of expensive aerial retardant drops during fire behavior conditions that have no chance of success, or suppressing interior hotspots that have no chance of escaping the wildfire perimeter just to reduce the public’s perceived fear of fire spread. These political considerations can actually be the driving force behind specific suppression decisions, and can have major influences on costs.⁸² One of the most common “political shows” is the use of heavy airtankers or Type I

helicopters—a major cost center on large wildfires—even when they are largely ineffective because they display to the public or media that the government is actively and aggressively attacking the wildfire.⁸³



A “blank check” attitude Congress has nurtured within federal agencies results in managers ordering expensive but unnecessary suppression actions, such as fire retardant drops on the shore of a pristine mountain lake.

Political shows are often the result of external “political meddling” that occurs at the upper levels of an agency, applied to line officers above the level of the IMT that is actually managing a wildfire. Pressure from elected officials gets handed internally down the chain of command to the IMT to implement more aggressive and more costly strategies and tactics. A related form of political meddling that increases suppression costs occurs when politicians or other VIPs and their large entourages make visits to fire camps. These visits typically includes airflights or driving tours not necessary for suppression operations but desired by the officials to get a closer view of the fire.⁸⁴ Visits by politicians often distract fire managers from the task of managing wildfire operations, require extra security and media personnel, and the high costs for managing these official visits are charged to the wildfire.

Public, political, and media pressure for firefighters to aggressively suppress wildfires are especially high when fires burn near the WUI. In these cases, most of the public expects firefighters to do whatever is possible in order to protect private property no matter what the expense.⁸⁵ This expectation of firefighter protection actually encourages new housing development in indefensible fire-prone locations, and lulls homeowners into a false sense of security and passivity in terms of mitigating fire hazards on their own lands. These both complicate wildfire management, increases the risks to firefighters, and raises costs. It also causes fire managers to focus their efforts on the WUI where their work may be futile instead of managing the fire in the wildland where actions might be more effective and even beneficial to the ecosystem.⁸⁶ In this sense, agencies must demonstrate that they do everything they can (and cannot) to “protect” structures rather than actually coherently manage the fire. This focus on managing public perceptions/expectations has definite cost implications.

The external influences of cultural expectations, political meddling, and media relations all pressure fire managers to opt for aggressive suppression and ignore its costs instead of choosing less costly fire use strategies or modified suppression tactics. Changes in policy or operations to encourage more fire use for ecological benefits, or adhere to cost containment goals, will likely prompt strong external opposition

especially from private landowners, individual homeowners, or community leaders because they face potential risks of wildfire damage, but they are not directly responsible for the costs of suppression. Yet, a century of aggressive suppression has revealed that there are significant ecological risks and economic costs associated with failing to let more fires burn.⁸⁷

In many respects, higher suppression and/or fuels reduction costs are shunted into the future with each “successful” effort to contain or control fire. Indeed, the Forest Service’s Inspector General concluded that by fighting many fires that could have been managed with fire use tactics, the agency missed many opportunities to let fire reduce hazardous fuels, and spent millions of dollars on suppression.⁸⁸ The current pro-suppression system is simply unsustainable, yet the public will continue to expect that agencies will suppress most wildfires unless and until the financial burden is shifted away from the federal government onto States and local communities or individual homeowners.⁸⁹ Serious work needs to be done to change the societal expectations to put out all wildfires. Changing societal expectations will require a compelling narrative linking residential and firefighter safety with ethical and ecological land stewardship. Strong and durable talking-point memes must be developed to counter the prevailing suppression ideology, private profit motives, and bureaucratic inertia. Given ample data on the costs and impacts of wildfire suppression, and knowledge of the ecological and economic benefits of fire use, it is more a lack of political will within the agencies that impedes their ability to resist external political pressure to fight all fires.⁹⁰

Internal Factors: Leadership Accountability and Risk-Aversion

The least-discussed set of explanations for the rise of suppression expenditures are “internal” agency pressures related to its pro-suppression policy bias, the general lack of oversight and accountability for suppression expenditures, the lack of incentives for managers to contain costs, the general aversion of managers to take risks to manage wildfires for resource/ecological benefits or opt for anything less than full suppression, and poor decision-making by land and fire managers in their choice of suppression strategies and tactics.

Agency Bias for Suppression and Lack of Accountability for Reducing Costs

As discussed above, federal land and fire managers experience intense pressure from the general public, politicians, and the media to fight fires, but this “external” pressure coexists with a strong internal bias in favor of suppressing wildfires that goes back to the origins of the Forest Service. Over the last century, firefighting has delivered essential public, political, and financial support to the agency, and with almost half of its annual budget now devoted to suppression, it is fast becoming its core mission. This “internal” pressure leads the agency to aggressively attack and suppress over 98% of all wildfire ignitions, regardless of the cause, location, or conditions of the fire, and with hardly any thought as to the risks, costs, or impacts of aggressive firefighting. More ecologically enlightened policies that would allow alternatives to aggressive suppression have been on the books for nearly 30 years, but Forest Service practices lag many years behind its fire management policies.⁹¹ The task of containing suppression costs will never be successful until the internal bias of managers that favor “fighting fires” is changed.

Related to this internal institutional bias in favor of fire suppression lurks a widespread lack of accountability for reducing suppression costs.⁹² In a survey of fire managers by NASF, nearly a quarter of the respondents said that a lack of accountability or incentives to reduce costs is one of the two most significant factors contributing to rising suppression costs.⁹³ While suppression “cost effectiveness” has

been a goal within the Forest Service for over 15 years, there has never been an analysis of what suppression strategies or tactics might be cost effective.⁹⁴ Instead, essentially the old “10 am policy” of aggressive initial attack to quickly contain and control wildfires is *assumed* to be the most cost effective approach, but this externalizes the cost of future fuels reduction projects or wildfire suppression actions in the unburned fuels that result from stopping the wildfire.

Currently, “cost containment” has become the goal of federal agencies, but there is no real penalty for individual managers who ignore this goal and spend whatever they desire on firefighting operations. Thousands of personnel hours have been invested to produce dozens of reports and reviews that examined the factors underlying suppression expenditures, but their findings and recommendations have been routinely ignored, and there is no accountability for the agencies or individual managers to actually implement cost containment recommendations.⁹⁵

Because so much money can be spent so quickly during a wildfire “state of emergency,” it creates a huge potential for fraud, waste, and abuse of taxpayer dollars and resources, and in response to Congressional demands for greater cost accountability, the agencies have taken some positive steps to provide more oversight of suppression expenditures. Examples include the use of “Incident Business Advisors” (IBAs) on Incident Management Teams, daily cost reports, monitoring of resource orders for equipment and supplies, releasing crews as soon as possible, and cost reviews for suppression incidents that exceed \$10 million for Department of Interior incidents or \$5 million for Forest Service incidents.⁹⁶ A study by the Brookings Institute, however, determined that these measures would provide marginal savings of 5-10% at best.⁹⁷ Not an insignificant amount when suppression costs top over a billion years annually, but using IBAs to monitor spending will not lead to a qualitative reduction in suppression spending. Indeed, there is a difference between accounting and accountability, and improving the former does not necessarily ensure the latter.

Lack of Incentives for Fire Use and “Risk-Adverse” Managers

Along with the general lack of accountability there is a lack of incentives for managers to choose alternatives to aggressive or full suppression using whatever resources are available regardless of cost. Federal land and fire managers basically have an “open checkbook” attitude when it comes to devising strategies and tactics for managing wildfires, and the current incentive system rewards managers for suppressing wildfires, but places obstacles and imposes penalties for managing wildfires for resource benefits.⁹⁸ If anything, there is far more incentive to reduce the potential risk of wildfire damage, especially to private property, than there is to reduce the costs of wildfire suppression.⁹⁹

The issue of “risk aversion” among land and fire managers is becoming a major issue within the fire management community. This emerges in a couple of forms: managers’ aversion to take risks with the safety of firefighters or the public, and their aversion to take risks with their personal reputations or careers. The two kinds of risk aversions flow out of the tragic South Canyon, Thirtymile, and Cramer fires that killed firefighters and led to their incident commanders being subjected to internal investigations and even criminal prosecution for negligence. These incidents have caused many fire managers, perhaps rightly so, to believe that their agencies will not support them and that they will be held personally liable if something goes wrong.¹⁰⁰ Relatedly, many managers have the false perception that cutting costs also compromises firefighter safety. This causes them to both order an excessive amount of firefighting resources, and select more expensive capital resources like aircraft over less expensive labor resources like

handcrews.¹⁰¹ If any accident were to happen, managers could defend themselves with the claim that they employed every available resource at their disposal, holding nothing back from fighting the fire.

An increase in rules and regulations in the wake of these tragedy fires now makes it easier to inadvertently violate policies or procedures during the “heat of battle,” elevating the perception of risk of getting blamed for accidents or mistakes. Managers fear that they are not only risking their careers, but potentially face financial or criminal liability if a wildfire causes injuries or fatalities to firefighters or the public, and/or destroys private property, so they do whatever it takes to avoid these risks.¹⁰² This risk aversion usually results in choosing high-cost suppression strategies and tactics even if they are ineffective or excessive. For example, risk-adverse fire managers often order firefighters to perform “aggressive mop-up” (putting out all visible smokes and hotspots after the flame front has passed and fire spread has been contained) deep inside the interior of burned areas, even though there is a low risk of the fire escaping containment lines, and this kind of mop-up operations can account for half of the work hours on large fires.¹⁰³



Risk-adverse managers often request more firefighters than needed, and then hold onto them when they are no longer useful, which wastes taxpayer money and prevents crews from serving where they are genuinely needed.

Some fire managers have had their careers in fire management abruptly end when escaped prescribed fires or wildland fire use fires “blew up” and burned private property, but no manager has lost his or her job from ordering massive suppression resources or spending exorbitant taxpayer dollars to aggressively fight a wildfire.¹⁰⁴ There are simply far more internal incentives for managers to aggressively suppress wildfires and limit fire spread, and far more personal risks to them to contain costs or utilize wildfires for resource benefits. There needs to be a cost-benefit analysis of fire management strategies and tactics that incorporates the totality of management goals, for example, internalizing future suppression or fuels reduction costs for each “successful” suppression incident that stops fire spread, in order to evaluate what might be the most cost-effective methods for managing wildfires. However, unless and until the whole calculus of risk can be reversed such that aggressive and expensive suppression tactics become recognized as the *most* risky actions from firefighter safety, socioeconomic, and ecological perspectives (compared to monitoring or managing fires with minimum impact, low-cost tactics) then the issue of managerial risk aversion will continue to be another driver of rising suppression costs.

PART FIVE

LESSONS LEARNED, LOOKING TO THE FUTURE

SUMMARY

Wildfire activity has increased in the U.S. over the last 20 years, measured by the total increase in burned acres, and the growing frequency of large-scale, long-duration wildfires that the media has dubbed “megafires.” Coinciding with this rise in wildfire activity have been rapidly rising fire suppression costs. It is the largest 2% of all wildfires that consume 94% of total federal suppression expenditures. On a per-acre basis, firefighting is the most expensive kind of management activity that federal land management agencies perform. More and more suppression resources are being poured into the battle against blazes, burning up taxpayer dollars to corral wildfires that are increasingly becoming more difficult if not impossible to encircle and extinguish, at least until the weather changes.

Aggressive fire suppression in backcountry wildlands can be a “damned if you do, and damned if you don’t” kind of enterprise: it is a waste of money when large fires are aggressively fought during conditions that make them humanly uncontrollable (e.g. severe weather conditions prevail), or when small fires are put out during conditions that are suitable for utilizing the fire for resource or ecological benefits. Each “successful” suppression effort in remote wilderness/roadless areas represents a missed opportunity to reduce fuels or restore ecosystems with fire, and this externalizes the costs of future fuels projects or suppression actions in the areas where fire was suppressed and/or excluded. As well, expensive rehabilitation projects are required to mitigate the damage caused by excessive suppression actions.¹⁰⁵ There are plenty of ecological arguments against systematic fire suppression across the landscape, but the economics of suppression in remote backcountry wildlands or fire-dependent ecosystems are the most glaringly irrational—firefighting is almost all cost and no benefit.

Wildfire activity and suppression costs are rising mainly from the synergistic relationship of three socioenvironmental factors: growing fuels accumulations in part due to past (and still ongoing!) fire suppression, expanding housing developments in fire-prone environments, and unfolding climate change due to global warming. Excessive fuel loads have been depicted as the main culprit for large-scale wildfires since the early 1990s when the Forest Service and timber industry proclaimed a “forest health crisis” due to “overstocked stands of diseased, dead and dying trees.” The Bush Administration prioritized mechanical fuels reduction, especially commercial thinning, but the pace and scale of projects failed to keep up with escalating wildfire activity. Because it would cost billions of dollars to mechanically treat fuels across millions of acres of public wildlands, and all fuels treatments would have to be maintained in perpetuity in order to affect wildfire behavior, this is not a realistic strategy from an economic standpoint. Landscape-scale mechanical fuels reduction will not avoid taxpayer expenditures, but rather, merely shift funds from suppression to fuels reduction, causing a host of environmental impacts of its own. And the fact of the matter is that there are areas too steep, rugged, or remote for machines and people to work, making fire the most practical, economical, and ecologically-sound means of reducing fuels, especially the small-diameter surface fuels that spread wildfires.

Next to total fire size, the percentage of private property and human structures within a wildfire perimeter is the most significant factor driving up suppression costs. Managing fire to protect the WUI is more complex, costly, and is potentially the most hazardous assignment for firefighters. A single wildfire can

threaten hundreds of homes simultaneously, overwhelming the capacity of firefighters. Their jobs are made more difficult because many homes and communities are located in indefensible areas (e.g. steep slopes thick with flammable vegetation), are poorly designed or constructed (e.g. have flammable roofs or decks that are easily ignited by the tiniest of embers), or homeowners have not managed the vegetation within their “home ignition zone” (a 200 foot radius around structures that is the most critical area within the general WUI zone). Flexibility and mobility are two of firefighters’ best safety assets, but these are often compromised when they have to protect homes and communities that have no defensible space for safety zones or escape routes. Adding to the high danger associated with WUI wildfire protection is that because of the potential huge losses of citizens’ lives, homes, and businesses, firefighters often feel compelled to take greater risks. To mitigate these risks, fire managers usually order greater suppression resources—lots of crews and the “heavy metal” of aircraft and engines—even if these will be futile in stopping wildfire spread. These are the main factors that make WUI wildfire suppression so expensive.



It is economically and ecologically more rational to use expensive fire engines and other “heavy metal” suppression resources to protect at-risk frontcountry communities rather than fire-dependent backcountry wildlands.

Because the WUI zone may not offer the best fuel or terrain conditions for safe or effective suppression operations, firefighters are more often sent into backcountry wildlands to attack fires that may pose a risk--no matter how small the probability--of spreading toward the WUI. This not only results in an increase in direct suppression costs, but also an “opportunity cost” of failing to manage wildland fires for fuel reduction or forest restoration objectives. Thus, firefighters may either be sent to the WUI zone where some of the worst places for safe, effective wildland firefighting actions are located, or may be sent to backcountry areas to control fire in places or conditions that would otherwise be ideal for using fire use for resource benefits. Until communities are properly prepared for fire, the societal expectations for managers

to prevent home losses to wildfire at any and all costs—even if they are desperate, futile acts far away from the WUI--will continue to fuel higher suppression expenditures in the years ahead. Indeed, a 50% growth in housing development could raise annual suppression costs up to two to four billion dollars—literally doubling the Forest Service’s entire budget for fire suppression!

Global warming-caused climate change is the last but not least of the top three most-cited causes of rising suppression costs. Climate change has been the main cause of increases in the length of wildfire season, the number of total acres burned, and the growing frequency of large wildfires or “megafires” since the late 1980s. Climate change effects are just now beginning to show up in changes in weather patterns, precipitation regimes, and vegetation cover, all of which affect fire behavior. The agencies predict that in the near future 10-12 million acres will burn each year (compared to 6-8 million that currently makes up a “bad” fire season). A mere 1 degree Fahrenheit increase in average temperature is estimated will cause a 305% increase in area burned in the U.S. and a 107% increase in suppression costs just to protect the WUI. Few climate experts anticipate climate change to halt at just one degree increase, so this is likely a conservative estimate of the adverse effects of climate change on fire size and suppression costs. One thing seems clear: climate conditions conducive to large-scale, long-duration wildfires that defy human attempts to contain and control them will become the norm, and a *reactive* strategy based on emergency fire suppression to avoid the adverse impacts of fires to communities or ecosystems is doomed to fail, at a huge economic and ecological cost.

In addition to the above three socioenvironmental factors, there are some institutional factors within agencies that also account for rising suppression costs. The longstanding “open checkbook” attitude among land and fire managers is a major source of high-cost suppression incidents. The way Congress provides funding for fire management offers near-unlimited funding for reactive emergency suppression actions, but little or no incentives for proactive planning or restoration projects. Land and fire managers have no real fiscal constraints for spending whatever they desire on firefighting actions, and despite numerous reports and recommendations on the issue of cost containment, they face no accountability for failing to control costs. The system of deficit spending and budget borrowing provides a perverse incentive to focus on reactive suppression versus proactive fire and fuels management, especially when funding for all other government programs are generally declining.

Another institutional source of escalating suppression costs comes from the use of private firefighting contractors. Private contractors account for the majority of costs, taking roughly two-thirds of the dollars spent on large wildfire suppression incidents. Turning fire management from a government service into a profit-seeking business has not only raised costs, but has resulted in problems over the poor quality of services provided by some contractors. Thus, the promises that private contractors would provide better, cheaper, more efficient firefighting services have proven to be false. Nevertheless individual Congresspersons and land managers continue to promote the use of contractors mainly for ideological and political reasons. Even more ominous, the formation of a special interest group dependent on taxpayer dollars for firefighting creates an organized opposition to the effort to contain costs, and poses a threat to progressive policy changes that would help shift the agencies from emergency fire suppression to well-planned fire management.

Finally, another institutional factor underlying rising suppression costs is due to the cost-share agreements between the federal and state governments that requires federal agencies to pick up most of the tab for fighting multi-jurisdictional wildfires. The States have rightly criticized the land management policies and practices of federal agencies that resulted in elevated hazardous fuel loads that, in turn, increase the wildfire risks to State and private lands, but the States and private landowners have wrongly opposed the

expanded use of fire that could reduce those fuels. The Feds are right in criticizing State, County, and local governments for lax regulation of housing development in fire-prone landscapes. Oftentimes the main reason that federal agencies feel compelled to fight fires on federal lands is because communities are located in high-risk fire zones, and have failed to prepare plans or treat hazardous fuels on private lands within the WUI.

Many State and local governments have not just failed to enact or enforce land use zoning, building codes, or vegetation management ordinances that would eliminate or mitigate the wildfire risks to communities—they are ideologically or politically opposed to them. Federal wildfire protection thus functions as a kind of subsidy if not perverse incentive for sprawling WUI development. States and counties receive all the tax benefits from development in the WUI, but do not pay their fair share of the costs for suppression or recovery efforts that benefit local communities at the expense of taxpayers nationwide. Simply shifting some of the suppression costs from the federal government to State and County governments would not, by itself, directly reduce those costs. However, having greater equity in paying for suppression would provide incentives for local governments to regulate WUI development and prepare communities for wildfire. This would indirectly reduce costs by eliminating the need for some fire suppression actions, especially on distant backcountry fires on federal lands.

In addition to the socioenvironmental and institutional factors that are fueling increased suppression spending, costs are heavily influenced by operational factors or the very strategies and tactics that fire managers select to manage wildfires. These operational factors are among the least examined issues presented in all the various reports and investigations of suppression spending, yet in many respects, they are the most critical. One operational factor concerns the “external” cultural or political pressure of societal expectations placed on fire managers to select aggressive initial attack and full suppression as their preferred response to wildfires. Due to Smokey Bear social conditioning, most people and the politicians they elect want all wildfires to be put out as swiftly as possible, and typically oppose prescribed burning, fire use, or other alternatives to total fire suppression. Fire managers order aggressive suppression and full perimeter control even during conditions that make these efforts highly risky to firefighters or are ineffective—a waste of taxpayer dollars done for “political shows.”

Relatedly, politicians also conduct their own “political shows” that impose high costs when they visit fire camps with large entourages of aids and reporters. On these visits they usually insist upon observational flights or driving tours, meetings with fire commanders, and photo-ops with firefighters, all of which can distract managers and crews from their prime tasks at hand, and costs money that is charged to the suppression account. Even fire managers who understand the economic costs and ecological impacts of suppression cannot or will not resist the external pressure to fight nearly all wildfires. As long as the majority of the public, politicians, and the press consider firefighting to be “heroic” and the “moral equivalent of war,” support for firefighting-at-all-costs will continue to raise the costs of suppression operations.

Another operational factor that imposes “internal” pressure on managers to select aggressive suppression responses concerns leadership issues: managers who are adverse to career risks and lack accountability for their decisions and actions. There is a double standard within the agencies such that prescribed burning projects must go through lengthy and expensive public planning processes, and must be paid for by fixed budgets, while firefighting does not require any of that—managers have maximum discretion with little to no public accountability or fiscal constraints. Moreover, if a prescribed fire escapes its management boundaries, or if a fire use incident burns private property, managers face intense public anger and it may be a “career-ending event.” But if homes are destroyed from a poorly-executed backfire that causes a

wildfire to “blow up,” then that manager will be forgiven if they even face any public or professional criticism at all. In essence, managers are vilified if accidents occur when they are using fire, but are normally absolved of any blame if and when accidents occur while they are fighting fire. This double-standard between fire suppression and fire use accidents accounts for what some critics have called “risk-adverse” managers, another internal operational factor underlying rising suppression costs.



Expensive suppression resources are often used for mundane tasks such as using helicopters to “mop-up” a blaze that is no longer spreading and will soon go out.

The label of “risk-adverse” applies to those managers who select aggressive fire suppression actions in order to avoid potential public controversy or professional criticism for selecting less aggressive fire use actions. However, it is a misnomer to call them “risk-adverse.” In fact, they are comfortable with creating risk for firefighters by exposing them to the inherent health and safety hazards of aggressive firefighting. Every year on average a couple dozen firefighters, most of them young women and men, lose their lives while firefighting. The potential loss of life or limb of firefighters does not normally factor into the economic costs of suppression, but it should.

There are hazards, including fatal accidents, associated with prescribed burning and fire use, too, but these are generally less hazardous and far safer actions than aggressive suppression. There are also risks to management programs that may go unfunded because so much money is being spent on suppression. Although most people believe that allowing wildfires to burn is risky, it is equally if not more true that there are significant risks in *not* allowing wildfires to burn. Unless and until the calculation of risk is inverted so that sending people and/or spending taxpayer dollars on suppression actions are viewed as the most risky thing for a manager’s career or reputation, while igniting prescribed fires or using wildland fires are seen as the least risky decisions by a manager, then suppression costs will continue to increase through the external and internal biases constantly favoring suppression responses to wildfires.

CONCLUSION: CONTROLLING SUPPRESSION COSTS

As this paper has demonstrated, there are a number of socioenvironmental, institutional, and operational factors that are driving up the cost of wildfire suppression. Over the last fifteen years as this issue has become a growing public and professional concern, there have been literally dozens of reports great and small that have offered hundreds of recommendations for controlling or containing suppression costs. The bibliography at the end of this paper provides the references to many of these reports. Unfortunately, few of these reports' recommendations have been implemented. Still, the issue remains: wildfire suppression and its escalating cost is economically, socially, and ecologically unsustainable.

It is beyond the scope of this paper to address all of the proposed solutions to rising suppression spending that have been offered to date, but there should be some kind of blue ribbon commission or federal advisory panel that conducts a comprehensive review of these recommendations, and devises some kind of action plan for implementing them. What follows are a few general ideas for a place to start crafting more specific solutions for each of the factors discussed in this paper. One thing is for sure: taxpayers and other concerned citizens are going to have to push Congress and the Administration to get serious about imposing hard limits on suppression spending, and create real alternatives to business-as-usual firefighting that is quite literally becoming another big business.

In addressing socioenvironmental factors, there is no way it will be economically possible to mechanically treat all the acres of public land needing fuels reduction. Ultimately, wildfire is going to be the primary means of reducing and managing fuel loads across the landscape. Not only is fire the least expensive, but it is also the most natural and ecologically sound means of doing this. However, this is not a call for a passive, "let burn" program, particularly in areas where excessive fuels will likely result in uncharacteristically high-severity effects. In the short-term, what could be done is to construct fuelbreaks in some high-priority sites that offer potential "anchor" sites for managing future fires. Forest Service scientist, Dr. Mark Finney, offers a "fuels treatment optimization" model for making smart choices for these strategically placed fuelbreak sites.¹⁰⁶ By using his model, treating fuels on a small portion of the landscape enables crews to manage fire across a much larger area, at a fraction of the cost of manipulating the entire landscape. More importantly, any manipulation of the environment, including fuels management, must be grounded in fire ecology principles and sustainability values.¹⁰⁷

Suppression costs related to WUI protection will only start declining when new housing development is restricted and existing homes and communities take steps to properly prepare for fire. Forest Service scientist, Jack Cohen, offers the best science-based recommendations for reducing fire hazards within the critical "home ignition zone."¹⁰⁸ His work is inspiring programs such as FireWise and FireSafe Councils. A well-funded program to target community wildfire preparation would be a wise investment of taxpayer dollars because once the fear of wildfire destruction is reduced among rural residents and land managers, this will enable fire managers to utilize wildfire on the broader landscape to reduce fuels and restore ecosystems, further protecting communities. The nonprofit organization, Headwaters Economics, offers detailed analysis of 10 specific proposals for preventing and mitigating wildfire risks and hazards in the WUI, and each one of them could result in real cost savings.¹⁰⁹

The issue of climate change is immense and will require fundamental societal change in order to fully address. Reducing human-caused emissions of greenhouse gases is simultaneously the easiest and most

difficult solution, but even an immediate cessation of fossil fuel burning today will not result in a tangible reduction in wildfire activity in the near future. There is considerable interest among policymakers for protecting forests for their carbon sequestration capacity, and this is creating a new rationale for even more aggressive and expensive suppression efforts. But ramping up suppression efforts to try to exclude fire and save every stick of forest carbon from wildfire will cause its own ecological problems, and will ultimately fail as the past century of attempted fire exclusion is failing to prevent all wildfires. Instead, the nonprofit organization, Association for Fire Ecology, urges land managers to utilize fire management techniques to help ecosystems adapt to climate change, and to maximize long-term forest carbon stores.¹¹⁰ By working *with* fire to reduce the amount of small-diameter understory vegetation that holds the least carbon but provides fuel for high-intensity wildfires, managers can enhance the natural fire resistance of large-diameter trees and soils that hold the most carbon. This counterintuitive strategy of *using* fire rather than fighting fire has the best chance of maximizing long-term carbon storage, as well as helping ecosystems adapt to ongoing climate change.

In addressing institutional factors that are driving higher suppression costs, Congress must end the “blank check” budgetary structure and set of perverse incentives for wildfire suppression. The FY2010 Interior Appropriations Act authorized and funded the FLAME Act, which partitions suppression budgets into normal “initial attack” and emergency “catastrophic wildfire” efforts. This will provide more transparent accounting for expenditures on small versus large wildfires, but will not end the practice of deficit spending or budget borrowing unless and until Congress establishes some hard budgetary limits on suppression expenditures. As well, Congress needs to stop signaling to agencies in the normal appropriations process that they are willing to spend the majority of fire management funds on suppression activities. Congress needs to set fixed budgets and hard limits for suppression, forcing managers to be more strategic and selective with their use of firefighting resources, and then provide incentives for proactive fire management by allowing managers to take any unused suppression dollars at the end of the fiscal year and spend it on such things as fire planning, fuels reduction, and ecosystem restoration.¹¹¹ This would not necessarily save taxpayers’ money in the near term, but instead, would stop spending it on activities that damage ecosystems and degrade resources, while investing tax dollars on activities that sustain ecosystems and enhance resource values over the long term.

The growing use of private contract firefighting companies was propelled by ideological beliefs that prefer profit-seeking businesses over service-providing government agencies. There are some things like firecamp support and services that private businesses could perform better at less cost than agencies, and there are some things that local communities should be able to provide that will yield local economic benefits, but there are other things that businesses or communities cannot provide either at lower cost or higher quality than professional public agency crews. In particular, Congress should consider letting agencies purchase the essential aircraft, vehicles, and equipment that are known will be needed every fire season, and are some of the highest cost items used in firefighting, but are currently provided by contractors or private businesses. These purchases will actually increase taxpayer expenditures in the short-run, but save tax dollars in the long-run, and will be put in the hands of people motivated by a desire for public service rather than private profit. An expansion of the federal fire management workforce for duties beyond suppression work (e.g. fire planning, fuels management, fire effects monitoring) would also provide a number of socioeconomic and ecological benefits well worth the investment.

Renegotiating cost-share agreements between the federal and state governments are a necessary but insufficient means of reducing suppression costs, because simply shifting the balance of who pays for firefighting will not necessarily result in less suppression spending. However, the states and local county

governments must become more accountable for new housing development and fire hazard mitigation in the WUI, and forcing them to pay more of the costs of WUI wildfire protection would make it in their economic interest to reduce wildfire risks and hazards on lands within their jurisdiction. Regardless, taxpayers across the country deserve more equity between who pays and who benefits from federal wildfire protection.

The operational factors that are increasing suppression costs offer the greatest potential for immediate savings because the specific strategies and tactics used to manage wildfires—beginning with the initial decision whether or not to suppress a wildfire—have the most direct bearing on costs. Much, much educational work must be done to re-educate the public, elected officials, and the newsmedia about the ecological role of fire and the reasons for managing wildfires for resource benefits instead of simply “fighting” them. The Obama Administration’s new guidance for implementation of the federal wildland fire management policy provides plenty of authority for an expanded repertoire of fire management actions including simultaneous fire use and suppression actions.¹¹² But without full internal organizational support for doing alternative management approaches besides traditional suppression, managers know they risk “career suicide” if something disastrous results from fire use strategies (e.g. firefighters die or homes are destroyed).

The fact needs to be acknowledged, though, that firefighter fatalities and destroyed homes are annual occurrences despite—or in some cases *because of*—full suppression strategies and aggressive firefighting tactics. As climate change continues, the conditions that cause extreme fire behavior are only going to get worse unless and until hazardous fuel loads are reduced and fire-adapted ecosystems are restored—and fire is the most practical, ecological, and economical management “tool” to accomplish those tasks. New career incentives must be created to encourage managers to minimize the firefighter safety risks, taxpayer costs, and environmental damage caused from fighting fire while maximizing the social and ecological benefits of managing fire. With firefighter and public safety and community protection foremost in mind, every wildland ignition should be managed with this kind of “minimax” strategic thinking. Indeed, the normal risk assessment process that managers undertake must be reversed such that the *most* risky thing they do for their careers is to send firefighters into remote backcountry areas on “combat” missions to “fight” fire and put it out, while the *least* risky thing would be to work with fire, carefully managing its course across the landscape, to accomplish a suite of well-planned social and ecological objectives.

Managing fire across the landscape may not actually yield any immediate economic savings compared to traditional suppression, because it will still cost money to send crews with the right tools to manage wildfires safely and effectively. But these expenditures of tax dollars in ecological fire management will provide some positive long-term benefits to taxpayers and the land (e.g. improved forest health, restored habitat, reduced potential for future high-severity wildfire) as opposed to the ongoing negative environmental and ecological impacts of aggressive suppression. In this regard, the costs of ecologically managing wildfires should be viewed as land stewardship “investments” rather than expenditures.



Opting for low-cost fire use tactics in backcountry wildlands lets fire-dependent ecosystems enjoy the benefits of burning while conserving suppression resources for where they are needed most: protecting frontcountry communities

There will always be the need for suppression actions when wildfires threaten lives, homes, and communities, or when the adverse effects of fire threaten other desired social or ecological values. But fighting all fires in all places at any cost is simply not economically sustainable. Scattering suppression resources all over the landscape and fighting fires that could do beneficial ecological work not only poses a long-term opportunity cost that will require much greater future expenditures (e.g. fuels reduction projects or firefighting actions, likely during worse fire weather conditions), but it also creates immediate gaps in protection where firefighters are vitally necessary, such as the WUI zone. A far more rational strategy from both an economic and ecological standpoint would be to focus fire management resources on suppressing “frontcountry” wildfires located near communities, while managing “backcountry” wildfires in remote wildlands, fire-dependent ecosystems, roadless and wilderness areas. The current system of “total war” on wildfire is breaking the bank and cannot continue—we must become more strategic and selective in the fires we must suppress, and more opportunistic and receptive to the fires we can *use*.

POST-SCRIPT: THE COHESIVE STRATEGY FOR WILDFIRE MANAGEMENT

At the time of this writing (May 2010), federal agencies are developing a “Cohesive Strategy for Wildfire Management” in accordance with a Congressional mandate written into the FY2010 Interior Appropriations Act. The Government Accountability Office revealed back in 1999 that the Forest Service lacked some kind of cohesive strategy for managing fire and fuels, and in a series of reports over the last decade has critiqued some of the economic consequences resulting from this lack of strategic focus.¹¹³ The Forest Service drafted its own Cohesive Strategy in 2000, and this was shelved in order to develop an interagency plan with Department of Interior agencies in 2002, but the Bush Administration failed to complete or implement a final strategic plan, and promoted its “Healthy Forests Initiative” instead.

The Cohesive Strategy is still in the early drafting stage, but federal officials have hinted that given the extremely large scope and minimal time frame for the project, they are hoping to develop a kind of template for continued fire planning at the local, site-specific level. The Cohesive Strategy’s template will hopefully take an “all-lands” approach in that not only will fire planning be interagency, but will also encompass State and possibly private lands, too, building on the success of Community Wildfire Protection Plans. As well, the template may take an “all-communities” approach so that every community-at-risk from wildfire hazards in every region across the U.S. will be included. Finally, and most importantly, the template will take an “all-options” approach to fire management objectives, strategies and tactics. The overall goal of the Cohesive Strategy should be to foster fire-adapted communities, restore fire-dependent ecosystems, and reduce the risks, costs, and damages of wildfires and fire suppression.

The hope is that the Cohesive Strategy will continue the progressive trend in fire policy reform that began soon after the Obama Administration took office. In March of 2009 the Administration authorized one of the most profound changes in fire management policy in the last 40 years. The Administration’s new “Guidance for Implementation of the Federal Wildland Fire Policy” ends the bifurcation in fire management between fire suppression and fire use, and allows every wildfire to be managed for multiple objectives concurrently.¹¹⁴ This means that fire managers can choose “point protection” rather than “perimeter control” strategies, focusing suppression resources on the specific sites where they are needed. Thus, for example, crews may aggressively suppress one part of a wildfire in order to protect a threatened community, while on another portion of the same fire, they may apply fire use or simply monitor its natural spread into uninhabited wildlands in order to fulfill fuels reduction or forest restoration goals. This new policy enables wildfires to be managed with both economic rationality (i.e. fire use and fire monitoring are generally far less expensive than full suppression with perimeter control) and ecological rationality (i.e. enabling fire to play its natural and necessary ecological role).

The most valuable contribution of the Cohesive Strategy may be to inspire a new round of fire management planning. The creation of fire management plans (FMPs) was one of the hallmarks and highest priorities of the Federal Wildland Fire Management Policy.¹¹⁵ According to the Fire Policy, agencies were required to develop FMPs for “all areas subject to wildland fire.” These plans were supposed to be interagency, based on the best available science, and include a full range of fire management actions to integrate both fire protection and fire use. Unfortunately, previous Administrations and Congress neglected to prioritize or fund the development of FMPs despite the Forest Service’s realization a decade ago that for every dollar it spent on it planning and preparation the agency saved five

to seven dollars in fire suppression and rehabilitation costs.¹¹⁶ More recently, researchers used an econometric model to determine that each dollar increase in suppression costs reduces potential resource damage by 12 cents, but each dollar invested in pre-suppression preparedness activities like fire planning reduces suppression expenditures by \$3.76, making an investment in fire management planning much more cost-effective than the “blank check” approach to funding fire suppression.¹¹⁷ If the Cohesive Strategy inspires new fire planning that enables managers to use fires for resource benefits and avoid unnecessary suppression actions, then tangible taxpayer savings may result in the near term.

Given the fact that climate change will cause many wildfires to burn larger and longer, the real issue in the near future will not be cost reduction or even cost containment, but rather, cost *management*. Expenditures may still remain high as the amount of burned acres continues to grow up to a predicted 10-12 million acres per year.¹¹⁸ Indeed, there are sound arguments for actually increasing appropriated budgets for federal fire management.¹¹⁹ However, on both economic and ecological grounds, the conventional “warfare” approach to “fighting” fire is inefficient, ineffective, irrational, and unsustainable.¹²⁰ If the Cohesive Strategy supports the Obama Administration’s progressive reforms of the Federal Fire Management Policy, then future wildfires will be appropriately *managed* in ways that maximize the social and ecological benefits of burning, while minimizing firefighter risks, property damages, and taxpayer costs.¹²¹ Using wildfires to achieve long-term fuels reduction and ecosystem restoration goals will make the expense of managing wildfires become more like investments in ecosystem restoration and land stewardship rather than “costs.” But, it all depends upon federal agencies taking this historic opportunity to complete the paradigm shift from “fire control to fire management,” and change the focus from fighting *against* fire to working and living *with* fire. One thing seems clear: over the last century fire control was itself out of control, breaking the bank and subverting the conservationist missions of federal agencies. Any effort to contain or control costs must begin with the economically and ecologically rationale step of controlling the over-use of overaggressive wildfire suppression, instilling more accountability in agencies and creating more incentives for fire managers to implement the most *socially* and *ecologically appropriate* management responses to wildfire.



BIBLIOGRAPHY

- Association for Fire Ecology. 2006. The San Diego Declaration on Climate Change and Fire Management. AFE Position Paper presented at the Third International Fire Ecology and Management Congress on November 15. http://fireecology.net/docs/San_Diego_Declaration_on_Climate_Change.pdf
- Association for Fire Ecology. 2009. The Role of Fire in Managing Long-Term Carbon Stores: Key Challenges. AFE Position Paper adopted December 3. http://fireecology.net/docs/AFE_2009_Position_Paper_Carbon.pdf
- Aplet, Greg; and Bo Wilmer. 2005. The Wildland Fire Challenge: Protecting Communities and Restoring Ecosystems. *The George Wright Forum* 22(4):32-44.
- Berry, Alison. n.d. Forest Policy Up in Smoke: Fire Suppression in the United States. Property and Environment Research Center.
- Busby, Gwendolyn, and Heidi Albers. 2010. Wildfire Risk Management on a Landscape with Public and Private Ownership: Who Pays For Protection? *Environmental Management*. DOI 10.1007/s00267-009-9381-x.
- Calkin, David; Krista Gebert, Greg Jones, and Ronald Neilson. 2005. Forest Service Large Fire Area Burned and Suppression Expenditure Trends, 1970-2002. *Journal of Forestry* 103(4):179-183.
- Canton-Thompson, Janie; Brooke Thompson, Krista Gebert, David Calkin, Geoff Donovan, and Greg Jones. 2006. Factors Affecting Fire Suppression Costs as Identified by Incident Management Teams. U.S.D.A. Forest Service Rocky Mountain Research Station. Research Note RMRS-RN-30. April.
- Canton-Thompson, Janie; Krista Gebert, Brooke Thompson, Greg Jones, David Calkin, and Geoff Donovan. 2008. External Human Factors in Incident Management Team Decisionmaking and Their Effect on Large Fire Suppression Expenditures. *Journal of Forestry*. December. Pgs. 416-424.
- Cart, Julie; and Bettina Boxall. 2008. Air Tanker Drops in Wildfires are Often Just for Show. *Los Angeles Times*. July 29.
- Cohen, Jack. 1999. Reducing the Wildland Fire Threat to Homes: Where and How Much? *Proceedings of the symposium on fire economics, planning, and policy: Bottom lines*. U.S.D.A. Forest Service Pacific Southwest Research Station General Technical Report PSW-GTR-173. pgs. 189-195.
- Dale, Lisa; Gregory Aplet, and Bo Wilmer. 2005. Wildland Fire Use and Cost Containment: A Colorado Case Study. *Journal of Forestry*. September. Pgs. 314-318.
- Dombeck, Michael; Jack Williams, and Christopher Wood. 2004. Wildfire Policy and Public Lands: Integrating Scientific Understanding with Social Concerns Across Landscapes. *Conservation Biology* 18(4):883-889. August.
- Donovan, Geoffrey. 2005. A Comparison of the Costs of Forest Service and Contract Fire Crews in the Pacific Northwest. *Western Journal of Applied Forestry* 20(4):233-239.
- Donovan, Geoffrey; and Thomas Brown. 2005a. Incentives and Wildfire Suppression Policy. U.S.D.A. Forest Service Pacific Northwest Research Station. September.
- Donovan, Geoffrey; and Thomas Brown. 2005b. An Alternative Incentive Structure for Wildfire Management on National Forest Land. *Forest Science* 51(5):387-395.
- Donovan, Geoffrey; and Thomas Brown. 2007. Be Careful What You Wish For: The Legacy of Smokey Bear. *Frontiers in Ecology and Environment* 5(2):73-79.
- Donovan, Geoffrey; Peter Noordijk, and Volker Radeloff. 2004. Estimating the Impact of Proximity of Houses on Wildfire Suppression Costs in Oregon and Washington. *Proceedings of the Second International Symposium on Fire Economics, Planning, and Policy: A Global View*. Pgs. 697-701.

- Ferry, Gardner. 1999. Federal Funding of Wildland Fire Management Programs: What Will One Billion Dollars Buy? *Proceedings of The Symposium on Fire Economics, Planning, and Policy: Bottom Lines*. U.S.D.A. Forest Service Pacific Southwest Research Station General Technical Report PSW-GTR-173. pgs. 15-18.
- Finney, Mark. 2007. A Computational Method For Optimizing Fuel Treatment Locations. *International Journal of Wildland Fire* 16:702-711.
- Fire Executive Council. 2009. Quadrennial Fire Review. U.S. Department of Interior; U.S. Department of Agriculture-Forest Service; National Association of State Foresters.
- Fireground Communications. 2009. Obama Signs Bill To Help Agencies Manage Skyrocketing Wildfire Suppression Costs. November 2. <http://fireground.com/?p=1897>.
- Forbes, Alice. 2005. Wildland Fire Situation Analysis Most Cost Effective Alternative. U.S. Department of Agriculture—Forest Service Washington Office, Fire and Aviation Management memorandum to Regional Fire Directors. dated June 28.
- Gebert, Krista; and Ervin Schuster. 1999. Predicting National Fire Suppression Expenditures. *Proceedings of the Symposium on Fire Economics, Planning, and Policy: Bottom Lines*. U.S.D.A. Forest Service Pacific Southwest Research Station General Technical Report PSW-GTR-173. pgs. 21-30.
- Gebert, Krista. 2007. Wildfire suppression costs. *Montana Business Quarterly*. September 22.
- General Accounting Office. 1999. Western National Forests: A Cohesive Strategy is Needed to Address Catastrophic Wildfire Threats. Report to the U.S. House Subcommittee on Forests and Forest Health. GAO/RCED-99-65. April.
- General Accounting Office. 2004a. Biscuit Fire: Analysis of Fire Response, Resource Availability, and Personnel Certification Standards. GAO-04-426. April.
- General Accounting Office. 2004b. Wildfire Suppression: Funding Transfers Cause Project Cancellations and Delays, Strained Relationships, and Management Disruptions. GAO-04-612. June.
- Government Accountability Office. 2005. Wildland Fire Management: Important Progress Has Been Made, But Challenges Remain to Completing a Cohesive Strategy. January.
- Government Accountability Office. 2006a. Wildland Fire Suppression: Lack of Clear Guidance Raises Concerns About Cost Sharing Between Federal and Nonfederal Entities. GAO-06-570. May.
- Government Accountability Office. 2006b. Wildland Fire Suppression: Better Guidance Needed to Clarify Sharing of Costs Between Federal and Nonfederal Entities. Testimony Before the U.S. Senate Subcommittee on Public Lands and Forests, Committee on Energy and Natural Resources. GAO-06-896T. June 21.
- Government Accountability Office. 2007a. Wildland Fire Management: Lack of Clear Goals or a Strategy Hinders Federal Agencies' Efforts to Contain the Costs of Fighting Fires. GAO-07-655. June.
- Government Accountability Office. 2007b. Wildland Fire Management: A Cohesive Strategy and Clear Cost-Containment Goals are Needed for Federal Agencies to Manage Wildland Fire Activities Effectively. GAO-0701017T.
- Government Accountability Office. 2009a. Wildland Fire Management: Federal Agencies Have Taken Important Steps Forward, but Additional Action is Needed to Address Remaining Challenges. Testimony Before the U.S. Senate Committee on Energy and Natural Resources. GAO-09-906T. July 21.
- Government Accountability Office. 2009b. Wildland Fire Management: Federal Agencies Have Taken Important Steps Forward, But Additional, Strategic Action is Needed to Capitalize on Those Steps. GAO-09-877. September.

- Gude, Patricia; J. Anthony Cookson, Mark Greenwood, and Mark Haggerty. n.d. Homes in Wildfire-Prone Areas: An Empirical Analysis of Wildfire Suppression Costs and Climate Change. Headwaters Economics.
- Headwaters Economics. 2009. Solutions to the Rising Costs of Fighting Fires in the Wildland-Urban Interface. December.
- Headwaters Economics. n.d. Cost of Fighting Fires on Public Lands. 4 pgs.
- Hesseln, Hayley and Douglas Rideout. 1999. Economic Principles of Wildland Fire Management Policy. *Proceedings Of The Symposium On Fire Economics, Planning, And Policy: Bottom Lines*. U.S.D.A. Forest Service Pacific Southwest Research Station General Technical Report PSW-GTR-173. pgs. 179-187.
- Independent Large Wildfire Cost Panel. 2007. Towards a Collaborative Cost Management Strategy: 2006 U.S. Forest Service Large Wildfire Cost Review Recommendations. The Brookings Institute. May 15.
- Ingalsbee, Timothy. 2000. Money to burn: The economics of fire and fuels management. Western Fire Ecology Center. June. http://www.fusee.org/docs/SuppressionCosts/money_to_burn_copy.html
- Ingalsbee, Timothy. 2006. Collateral Damage: The Environmental Effects of Firefighting: The 2002 Biscuit Fire Suppression Actions and Impacts. Firefighters United for Safety, Ethics, and Ecology. May. http://www.fusee.org/docs/SuppressionImpacts/FUSEE_Collateral_Damage_Biscuit_Fire_Report.pdf
- Lankoande, Mariam and Jonathan Yoder. 2006. An Econometric Model of Wildfire Suppression Productivity. Washington State University School of Economic Sciences Working Paper Series 2006-10. September.
- Liang, Jingjing; Dave Calkin, Krista Gebert, Tyron Venn, and Silverstein, Robin. 2008. Factors Influencing Large Wildland Fire Suppression Expenditures. *International Journal of Wildland Fire* 17:650–659.
- Mangan, Richard. 1999. Issues in Large Wildfire Suppression Cost Reduction: An Operational Perspective. *Proceedings of the symposium on fire economics, planning, and policy: Bottom lines*. U.S.D.A. Forest Service Pacific Southwest Research Station General Technical Report PSW-GTR-173. pgs. 31-35.
- National Academy of Public Administration. 2002. Wildfire Suppression: Strategies for Containing Costs. September.
- National Association of State Foresters. 2000. Cost Containment on Large Fires: Efficient Utilization of Wildland Fire Suppression Resources. U.S.D.A. Forest Service State and Private Forestry. July 1.
- National Association of State Foresters. 2007. Issue Paper: Federal Wildland Fire Suppression Costs: Budget Reform. April 24.
- National Wildfire Coordinating Group. 1999. Incident Business Advisor Guide. PMS 314. August.
- Office of the Inspector General, Western Region. 2006a. Audit Report: Forest Service Firefighting Contract Crews. Report No. 08601-42-SF. March.
- Office of the Inspector General, Western Region. 2006b. Audit Report: Forest Service Large Fire Suppression Costs. Report No. 08601-44-SF. U.S. Dept. of Agriculture. November.
- Oppenheimer, Jonathan. 2000. From the Ashes: Reducing the Harmful Effects and Rising Costs of Western Wildfires. Taxpayers for Common Sense. December.
- O'Toole, Randall. 2002. Reforming the Forest Service: An Analysis of Federal Fire Budgets and Incentives. The Thoreau Institute.
- O'Toole, Randall. 2007. The perfect firestorm: Bringing forest service wildfire costs under control. Policy Analysis No. 591. Cato Institute. April 30.

- Rowdabaugh, Kirk. 2007. Controlling Wildfire Costs: Testimony to U.S. Senate Committee on Energy and Natural Resources. Western Governors' Association, National Association of Counties, National Association of State Foresters, International Association of Fire Chiefs. January 30.
- Schuster, Ervin; David Cleaves, and Enoch Bell. 1997. Analysis of U.S.D.A. Forest Service Fire-Related Expenditures, 1970-1995. . U.S.D.A. Forest Service Pacific Southwest Research Station Paper PSW-RP-230.
- Stephens, Scott and Lawrence Ruth. 2005. Federal Forest-Fire Policy in the United States. *Ecological Applications* 15(2):532-542.
- Strategic Issues Panel on Fire Suppression Costs. 2004. Large Fire Suppression Costs: Strategies for Cost Management. Wildland Fire Leadership Council. August. 26.
- Strategic Overview of Large Fire Costs Team. 2000. Policy Implications of Large Fire Management: A Strategic Assessment of Factors Influencing Costs. U.S.D.A. Forest Service, State and Private Forestry.
- The Wilderness Society. 2009. Facts About 2009 Wildfire Budget. <http://wilderness.org/content/facts-about-09-wildfire-budget>
- Truesdale, Denny. 1995. Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season. U. S. Department of Agriculture—Forest Service, Fire and Aviation Management, Washington Office.
- U.S. Department of Agriculture and U.S. Department of Interior. 2001. Review and Update of the 1995 Federal Wildland Fire Management Policy. January.
- U.S. Department of Agriculture—Forest Service; U.S. Department of Interior, National Association of State Foresters. 2003. Large fire cost reduction action plan. March.
- U.S. Department of Interior—National Park Service. 2004 Environmental Assessment. Sequoia and Kings Canyon National Parks.
- U.S. Department of Interior and U.S. Department of Agriculture. 2008. Interagency Large Fire Cost Review Guidebook. July.
- U.S. Department of Interior and U.S. Department of Agriculture. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy. February.
- U.S. Senate Committee on Energy and Natural Resources. 2007. Hearing on the Status of the Federal Land Management Agencies Efforts to Contain the Costs of Their Wildfire Suppression Activities and to Consider Recent Independent Reviews of and Recommendations for Those Efforts. January 30.
- Wassell, Charles and David Hedrick. 2005. Are There Economies of Scale in Fighting Wildfires? Unpublished working paper, Department of Economics, Central Washington University.
- Zimmerman, G. Thomas. 1999. Appropriate Management Responses to Wildland Fire: Options and Costs. *Proceedings of the Symposium on Fire Economics, Planning, and Policy: Bottom Lines*. U.S.D.A. Forest Service Pacific Southwest Research Station General Technical Report PSW-GTR-173. pgs. 255-267.



Additional resources for citizens interested in wildland fire ecology and management issues can be found at the FUSEE website www.fusee.org and check out the FUSEE blog at www.fusee.blogspot.com.

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ENDNOTES

- ¹ Krista Gebert, 2007.
- ² U.S. Department of Agriculture--Forest Service, et al. 2003. p.2.
- ³ Alison Berry, n.d. See also: U.S. Senate Committee on Energy and Natural Resources. 2007.
- ⁴ U.S. Department of Agriculture--Forest Service; et al. 2003. p.5.
- ⁵ Independent Large Wildfire Cost Panel. 2007. p.4.
- ⁶ Ervin Schuster, et al. 1997. p.7.
- ⁷ National Academy of Public Administration. 2002.
- ⁸ The Wilderness Society. 2009.
- ⁹ Headwaters Economics. 2009. p.6. See also: Headwaters Economics. n.d.
- ¹⁰ Jonathan Oppenheimer. 2000. p.1.
- ¹¹ Fireground Communications. 2009.
- ¹² David Calkin, et al. 2005.
- ¹³ Strategic Issues Panel on Fire Suppression Costs. 2004. p.9. See also: Government Accountability Office. 2007. And: David Calkin, et al. 2005.
- ¹⁴ Kirk Rowdabaugh. 2007. p.4.
- ¹⁵ Independent Large Wildfire Cost Panel. 2007. p.3.
- ¹⁶ U.S. Department of Agriculture--Forest Service, et al. 2003. p.16. See also: Alice Forbes. 2005. And: Krista Gebert, and Ervin Schuster. 1999.
- ¹⁷ Strategic Overview of Large Fire Costs Team. 2000.
- ¹⁸ Lisa Dale, et al. 2005.
- ¹⁹ National Academy of Public Administration. 2002. p.33.
- ²⁰ David Calkin, et al. 2005. p.8. See also: Strategic Issues Panel on Fire Suppression Costs. 2004. p.13.
- ²¹ Charles Wassell and David Hedrick. 2005.
- ²² Headwaters Economics. 2009. See also: National Academy of Public Administration. 2002.
- ²³ Greg Aplet and Bo Wilmer. 2005.
- ²⁴ U.S. Department of Interior—National Park Service. 2004. p.5-54.
- ²⁵ Headwaters Economics. 2009. p.7.
- ²⁶ Jingjing Liang, et al. 2008.
- ²⁷ National Academy of Public Administration. 2002. p.D-5.
- ²⁸ Ibid.
- ²⁹ Government Accountability Office. 2006a.
- ³⁰ Patricia Gude, et al. n.d. See also: Office of the Inspector General, Western Region. 2006a.
- ³¹ Krista Gebert, 2007.
- ³² Government Accountability Office. 2006a.
- ³³ Strategic Issues Panel on Fire Suppression Costs. 2004. p.13.
- ³⁴ National Academy of Public Administration. 2002. p.128.
- ³⁵ Headwaters Economics. 2009. p.11.
- ³⁶ Office of the Inspector General, Western Region. 2006b. p.10.
- ³⁷ Krista Gebert, 2007.
- ³⁸ Geoffrey Donovan, et al. 2004.
- ³⁹ Headwaters Economics. 2009.

-
- 40 Patricia Gude, et al. n.d.
- 41 Headwaters Economics. n.d. p.3.
- 42 Gwendolyn Busby and Heidi Albers. 2010. p.2.
- 43 Ibid.
- 44 Fire Executive Council. 2009
- 45 Headwaters Economics. 2009.
- 46 Patricia Gude, et al. n.d.
- 47 Ibid.
- 48 National Academy of Public Administration. 2002. p.43.
- 49 Alison Berry, n.d.
- 50 General Accounting Office. 2004b. p.7.
- 51 Ibid. p.3.
- 52 Ibid.
- 53 Scott Stephens and Lawrence Ruth. 2005.
- 54 Geoffrey Donovan and Thomas Brown. 2005a.
- 55 Hayley Hessel and Douglas Rideout. 1999. p.183.
- 56 Randall O'Toole. 2002.
- 57 Janie Canton-Thompson, et al. 2006. p.5.
- 58 Randall O'Toole. 2007. p.12.
- 59 Richard Mangan. 1999.
- 60 U.S. Department of Agriculture--Forest Service; et al. 2003. p.20.
- 61 National Academy of Public Administration. 2002. p.D-28.
- 62 U.S. Department of Agriculture--Forest Service; et al. 2003.
- 63 Julie Cart and Bettina Boxall. 2008.
- 64 Janie Canton-Thompson, et al. 2008. p.421.
- 65 Geoffrey Donovan and Thomas Brown. 2005b.
- 66 Geoffrey Donovan. 2005.
- 67 Janie Canton-Thompson, et al. 2008. p.421. See also: Office of the Inspector General, Western Region. 2006a.
- 68 General Accounting Office. 2004a. p.27.
- 69 Janie Canton-Thompson, et al. 2008. p.421.
- 70 U.S. Department of Agriculture--Forest Service; et al. 2003. p.20.
- 71 Geoffrey Donovan and Thomas Brown. 2005a.
- 72 Gardner Ferry. 1999.
- 73 Janie Canton-Thompson, et al. 2008. p.421.
- 74 National Academy of Public Administration. 2002. p.42.
- 75 Office of the Inspector General, Western Region. 2006b.
- 76 Gwendolyn Busby and Heidi Albers. 2010.
- 77 Government Accountability Office. 2006b. p.10.
- 78 Krista Gebert. 2007.
- 79 National Academy of Public Administration. 2002.
- 80 National Association of State Foresters. 2000. p.2.
- 81 Alison Berry. n.d.

-
- 82 Janie Canton-Thompson, et al. 2008. p.422.
- 83 National Academy of Public Administration. 2002. p.D-27. See also: Julie Cart and Bettina Boxall. 2008.
- 84 Janie Canton-Thompson, et al. 2006. p.4.
- 85 Office of the Inspector General, Western Region. 2006b. p.10.
- 86 National Association of State Foresters. 2000. p.7.
- 87 Geoffrey Donovan and Thomas Brown. 2005a.
- 88 Office of the Inspector General, Western Region. 2006b. p.14.
- 89 Headwaters Economics. 2009. p.10.
- 90 Geoffrey Donovan and Thomas Brown. 2007.
- 91 Jonathan Oppenheimer. 2000. p.12.
- 92 National Academy of Public Administration. 2002. p.71.
- 93 Ibid. p.76.
- 94 Office of the Inspector General, Western Region. 2006b. p.iv.
- 95 U.S. Department of Agriculture--Forest Service; et al. 2003. p.2. See also: Denny Truesdale. 1995.
- 96 Independent Large Wildfire Cost Panel. 2007. p.9. See also: U.S. Department of Interior and U.S. Department of Agriculture. 2008. And: National Wildfire Coordinating Group. 1999.
- 97 Independent Large Wildfire Cost Panel. 2007. p.9.
- 98 National Academy of Public Administration. 2002. p.77.
- 99 U.S. Department of Agriculture--Forest Service; et al. 2003. p.7.
- 100 Janie Canton-Thompson, et al. 2006. p.4.
- 101 David Calkin, et al. 2005. p.1.
- 102 Janie Canton-Thompson, et al. 2008. p.418.
- 103 National Academy of Public Administration. 2002. p.41.
- 104 Randall O'Toole. 2007. p.11.
- 105 Timothy Ingalsbee. 2006.
- 106 Mark Finney. 2007.
- 107 Michael Dombeck, et al. 2004.
- 108 Jack Cohen. 1999.
- 109 Headwaters Economics. 2009.
- 110 Association for Fire Ecology. 2006. See also: Association for Fire Ecology. 2009.
- 111 National Association of State Foresters. 2007. p.2.
- 112 U.S. Department of Interior and U.S. Department of Agriculture. 2009.
- 113 General Accounting Office. 1999. See also: Government Accountability Office. 2005, 2007a, 2007b, 2009a, 2009b.
- 114 U.S. Department of Interior and U.S. Department of Agriculture. 2009.
- 115 U.S. Department of Agriculture and U.S. Department of Interior. 2001.
- 116 Strategic Overview of Large Fire Costs Team. 2000.
- 117 Mariam Lankoande and Jonathan Yoder. 2006.
- 118 Fire Executive Council. 2009.
- 119 Scott Stephens and Lawrence Ruth. 2005.
- 120 Timothy Ingalsbee. 2000.
- 121 Thomas Zimmerman. 1999.