



Policy Implications of Large Fire Management: *A Strategic Assessment of Factors Influencing Costs*

A Report by the Strategic Overview of
Large Fire Costs Team



USDA Forest Service
State and Private Forestry

Strategic Overview of Large Fire Costs Team

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Big Bar Complex

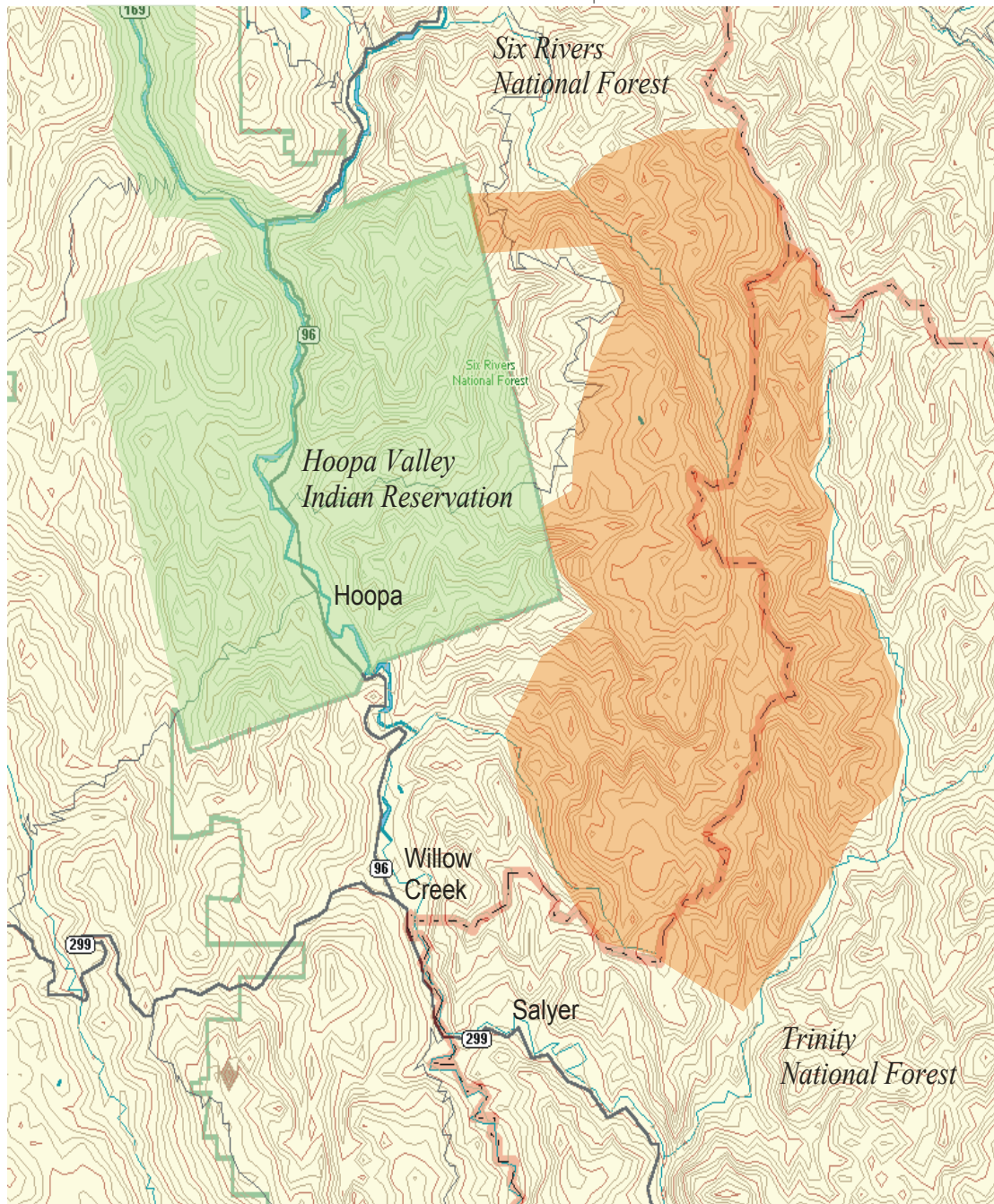
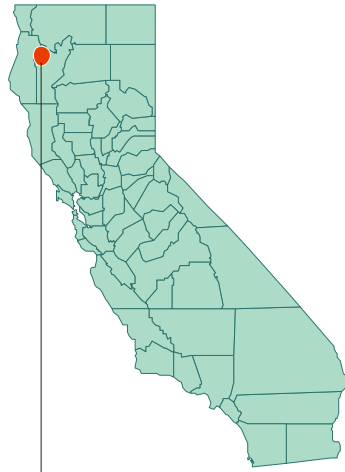
Acres burned: **140,907**

Cost: **\$81 million**

Fire duration:
August 23 - November 3, 1999



Fire Area



Kirk Complex

Acres burned: **86,700**

Cost: **\$97 million**

Fire duration:
September 8 - November 12, 1999



Table of Contents

Section	Page Number
Big Bar Fire Complex Map	i
Kirk Fire Complex Map	ii
Abstract	1
Preface	2
Executive Summary	3
Linkages with:	
• <i>An Agency Strategy for Fire Management</i> , Draft Report, November 15, 1999, USDA Forest Service	5
• <i>Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy</i> ”, December 3, 1999, USDA Forest Service	5
Foreword	7
The Team	7
The Team’s Charter	8
Introduction	8
A Synopsis of the Big Bar and Kirk Fire Complexes	9
Epilogue	12
Cost Categories in Fire Suppression.....	12
National Expenditures for Emergency Fire Suppression	14
Focus Questions	15
Literature Review	16
The Current Policy	19
Team Findings:	
• Themes	20
• Big Bar and Kirk Complexes Findings	21
• National Findings	22
Team Recommendations	29
Conclusions	31
Appendix A Interview Q&A’s	33
Appendix B Literature Used.....	38
Appendix C Literature Review <i>Analysis, Large Fire Strategy, Committee Report</i> , May 1996, USDA Forest Service	39
Appendix D Literature Review <i>Analysis, Large Fire Strategy, Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season</i> , August 1, 1995, USDA Forest Service	40
Appendix E Literature Review <i>Analysis, NASF Report on Efficient Utilization of Forest Fire Suppression Resources</i> , September 17, 1999, National Association of State Foresters.....	41
Appendix F Literature Review <i>Analysis, Western National Forests: A Cohesive Strategy to Address Catastrophic Wildfire Threats, Report to the Subcommittee on Forests and Forest Health, Committee on Resources, House of Representatives</i> , April 1999, The US General Accounting Office	42
Appendix G Land Management Considerations in Fire-Adapted Ecosystems: Conceptual Guidelines, August 1996, USDA Forest Service	42
Appendix H Course to the Future: Positioning Fire and Aviation Management, May 1995, USDA Forest Service	42
Appendix I Literature Review <i>Analysis, Fire Economic Assessment Report</i> , September 1, 1995, USDA Forest Service	43

Abstract

In late summer of 1999, lightning would strike Northern and Southern California and begin a three-month odyssey of wildland fire fighting that would eventually consume over 227,000 acres and cost about \$178 million to finally contain. This expenditure represents about 30 percent of the total Forest Service fire suppression budget in 1999. While initial reviews indicated sound reasons for the high costs, a more in-depth examination was called for. The subsequent examination *did not* identify anything that would have *significantly* reduced the costs of managing the Kirk and Big Bar Complexes.

However, many factors might have improved the overall efficiency of fire suppression efforts, and thus reduce some costs, including fire planning tiered to land management planning, and improved integration of risk analysis in fire management decisions. Improved initial attack capabilities, while not a clear consensus-problem on the two Complexes examined, did surface as an issue of national importance based on many discussions.

During the examination, several recommendations specific to the two Complexes and others of national concern were developed. The recommendations in this report reinforce recommendations made in several other past studies that have highlighted the need for important changes in the fire management program. The adequacy of recommendations is not the issue. Fundamental adjustments in fire management policy, funding, and organizational barriers, or in some cases the basic implementation of previous recommendations, must take place in order to redeem the role of fire management in the Forest Service for the 21st Century. Without these changes, the problems we face today will be the same ones we will experience well into the future with potentially greater costs and consequences.

Preface

In August 1949 thirteen firefighters were killed on a wildfire in western Montana called the Mann Gulch Fire. The fire was immortalized in the book by Norman Maclean entitled, “Young Men and Fire.” Forty-five years later on July 6, 1994 fourteen firefighters would perish on Storm King Mountain in Colorado. John N. Maclean, the son of Norman Maclean, documented this event in his recent book, “Fire on the Mountain, The True Story of the South Canyon Fire.” In the history of wildland firefighting, there have been other losses, perhaps less documented, but none-the-less just as costly. In reading these books and reviewing other incidents as part of the background information for this report, it is clear that the more things change, the more they stay the same. While today’s fire fighting is more complex, it remains a high-risk, extremely dangerous endeavor with a basic goal of protecting lives and property. The people who do this, from those on the line to those who provide support, are indeed a special breed. Most of us can only visualize what they do. We do not feel what they feel. We can, however, ensure modern firefighters are able to do their work safely, effectively, and at a reasonable cost.

This report, while examining two major fire Complexes in California in 1999, also attempts to refocus and bring attention to the need to place higher priority on fire management, in the broadest context. That is, from being better prepared to control fires when they are small, to managing a campaign for a fire that has become unmanageable, to fire planning and fuel reduction, to rehabilitation of the burned area, to achieving our overall stewardship vision of healthy trees, forests, and forest ecosystems.

The management of wildland fire and the forces required to do this job effectively represent a core business of the Forest Service; it is the script of our signature. Perhaps in the past, as stated in “Fire on the Mountain” and other reports, we lacked the fortitude or will to make necessary changes in the program to ensure it remains at a leading-edge level. The writers of this report tend to agree. We hope this report brings to light a renewed opportunity for change and equally important, emphases for the fire management program to help the agency better achieve its service and land stewardship mission.

The answer seems so simple: act now, establish wildland fire management as a top priority and begin to implement the recommendations that will ensure we meet our role and responsibility in protecting lives and property from wildland fires.

Executive Summary

In late summer of 1999, lightning would strike Northern and Southern California and begin three-months of intense fire fighting that would eventually consume over 227,000 acres and cost about \$178 million to finally contain. As a result, the Deputy Chief, State and Private Forestry called for an examination of the incidents, specifically the issue of high costs. The total expenditures for these two Complexes represented about 30 percent of the Forest Service fire suppression expenditures for FY 1999.

A team was assembled with the following charter:

- To determine if there are any underlying, unaddressed causes for the high costs associated with the Kirk and Big Bar Complexes.
- To assess the validity and practicality of remedies, if any, and suggest alternative actions with the explicit goal of reducing suppression costs without compromising firefighter safety.
- To use these two examples, in general, to draw conclusions about large fire management and associated costs and outline recommendations to adjust policies and program direction, as needed.

After careful analysis of the initial review of the Big Bar and Kirk Complexes, a formal interview with the involved Forest Supervisors and their staffs, discussions with Incident Commanders and support personnel that worked on the incidents, and many informal discussions or “mini-interviews” with other Federal, state, and local people, the team *did not* identify anything that we believe could have *significantly* reduced the costs of managing the Kirk and Big Bar Complexes. However, many factors did contribute to the high costs and these are highlighted as follows.

Factors inherent in the location or nature of the work include:

- Continued hot dry weather.
- Multiple fires across the Region constricting available resources.
- Smoke inversions restricting equipment use, particularly air operations.
- Rugged terrain that constrained management options.
- Wilderness and its associated policies.

Factors that require long-term strategies and significant investments to resolve:

- Heavy fuel.
- Limited access.
- Shortage of Type I crews and the lack of performance of Type II crews.
- Fire management planning.
- Disparity in firefighter pay.

Factors with potential to improve efficiencies in the short run:

- Contracting that allows economies of scale.
- Improved initial attack capabilities.
- Improved oversight at all levels.
- Red-carded Forest Service personnel not available due to a variety of causes.
- Tribal relationships on the Big Bar Complex.

Factors under the control of a Line Officer/Incident Management Team:

- Improved and consistent use of the Wildland Fire Situation Analysis (WFSa) process.
- Improved integration of risk analysis in fire management decisions.
- Indirect attack strategy required on both fires.
- Minimum Impact Suppression Techniques (MIST) that were required.

Several major recommendations that will improve the overall fire management program nationally include (the titles within the parenthesis represent the primary key point (s) of the National Wildland Fire Management Policy):

- Increase initial and extended attack resources. This includes budgeting for preparedness resources at the Most Efficient Level *to the field* and developing a cohesive, long-term budget strategy that includes preparedness, emergency suppression, fuel management, and state fire assistance in order to implement an effective, cost-efficient fire management program (*preparedness; prevention; suppression*).
- Implement fire management planning on a large scale, consistent basis. This includes tiering fire management planning to the Forest Land Management Plans and placing fire as an equal resource in the land management planning process. Community involvement and education is important (*planning*).
- Implement an aggressive fuel management program. This includes implementing recommendations from “Protecting People and Sustaining Resources in Fire-Adapted Ecosystems” (*wildland fire; use of fire*).
- Line officers must remain engaged in fire suppression actions to ensure the fire is managed in a safe and efficient manner. This includes providing a predominant message that costs are a priority and are expected to be as low as practicable in the management of the incident (*suppression; administration and employee’s roles*).
- Tribal relationships need to be well managed on incidents through experienced local liaison(s). This includes having all appropriate agreements in place (*interagency cooperation*).
- Update fire management technology to keep pace with today’s fire suppression complexities. This includes adjusting the NFMAS model to include the values associated with the wildland-urban interface adjacent to the National Forest Boundary and generally improve the quality of information included in the system. The use of the WFSA needs to be more consistent and aggressive, including using it in pre-fire planning to the extent practicable. Models like the Rare Event Risk Analysis Program and Fire Area Simulator should be improved and institutionalized (*planning; suppression; economic efficiency*).
- Reassess the emergency response capability to large fire suppression. This includes implementing, as appropriate, the “An Agency Strategy for Fire Management” (*safety; suppression; administration and employee’s roles*).

While both the Big Bar and the Kirk Complexes compare well on a cost per acre basis with historical averages, the combined suppression cost of \$178 million and the length of time it took to control these Complexes is what contributed to their significance. Further, the Big Bar and Kirk Complexes are indicators of similar conditions across the nation and should be viewed as examples of what the future will hold unless changes are made now in the fire management program.

Several reports, with over 100 recommendations, have been completed within the past five years that address fire management and associated cost issues. The adequacy of recommendations is not the issue. The agency does not seem to have the will to make the necessary policy, funding, and organizational adjustments to ensure that fire management is positioned to be the effective, cost-efficient program it needs to be for the 21st Century. Reestablishing the fire management program as a top priority within the agency is an important first step.

Linkages with “An Agency Strategy for Fire Management” and “Protecting People and Sustaining Resources in Fire-Adapted Ecosystems”

Two other major reports are being finalized. Their focus is efficient and effective fire suppression and ecosystem health through fuels management. The following matrix illustrates the linkages with the findings of the two aforementioned reports and this one, “Policy Implication of Large Fire Management: A Strategic Assessment of Factors Influencing Costs”, while cross walking with the key points of the Federal Wildland Fire Management policy.

Table 1. Program Linkages Between Three Fire Management Reports and the Federal Wildland Fire Management Policy, USDA Forest Service.

Key Points	Policy Implications	Agency Fire Strategy	Cohesive Fuels Strategy
Safety	Firefighter and public safety is the first priority.	Firefighter and public safety is the first priority.	Firefighter and public safety is the first priority.
Planning	Fire planning, tiered to the Forest Land Management Plan, and human resource management are critical and must be emphasized.	Integration of fire and fuel management program into land management planning is critical. Calls for some budget restructuring, an implementation team, and continuous monitoring.	Refers to ecosystem planning and planning for restoration work and fire regime analysis. This is critical. Calls for an independent entity to gather additional information.
Wildland Fire	Managed fire will improve our abilities to manage ecosystems, and improve strategies for large fire management.	Land management decisions include fire’s role in ecosystem dynamics and recognizes the critical role of the agency in wildland fire suppression.	A key component to help with excessive fuel loads. Forest stand condition classes establish areas of focus; about 40 million acres at high risk.
Use of Fire	Not specifically addressed but acknowledged that the lack of fuel management caused the fire campaign to be extended, especially regarding the Hoopa Indian Reservation lands.	Emphasizes treating high priority areas and developing an organization capable of total implementation of fuel management.	Emphasizes prescribed fire, along with mechanical treatments to reduce over-accumulation of fuel. The report calls for about \$135 million in management of fuel for year 1 of the strategy; about \$825 million by year 4 to be fully operational.
Preparedness	Maintain wildland fire protection capabilities for initial and extended attack at the Most Efficient Level (MEL) to the field. For FY 2000, the MEL is \$484 million. In FY 2001 the MEL is \$488 million. The FY 2001 proposed budget is \$355 million, about 73 percent of the MEL.	Recognizes the critical role of effective initial attack that would remain a local responsibility, but large-scale incident management needs a significant adjustment.	Maintain wildland fire protection capabilities for initial and extended attack at the Most Efficient Level (MEL). Supports the MEL at 100 percent at the field level.
Suppression	Fires are suppressed at minimum costs, considering firefighter and public safety, benefits, and values to be protected, consistent with resources objectives. Highlights the need for an expanded use of the WFSA.	Calls for a reassessment of emergency response capabilities for large fire suppression and other disasters. This includes a national strategy with our Federal and state partners.	Large fires can be decreased and more effectively managed if the strategy is implemented.

Key Points	Policy Implications	Agency Fire Strategy	Cohesive Fuels Strategy
Prevention	Not specifically addressed, except through reference to adequate levels of preparedness.	Will be addressed in implementation planning.	Not specifically addressed, except through reference to the MEL.
Protection Priorities	Protection priorities are (1) human life and (2) property and natural/cultural resources. The use of WFSA at pre-fire stages is critical. The WFSA needs to be strengthened as a tool and used more consistently and aggressively.	Places large incidents as an overall priority to be managed through a different organizational structure; retains local initial attack resources.	Prioritize fuels treatment. Focus on short-term interval ecosystems that are beyond the range of natural variability.
Interagency Cooperation	While cooperation is essential, the inequities of pay to Forest Service employees caused by use of interagency resources must be addressed.	Addresses why many of our cooperators see our large-scale mobilization efforts as inefficient; report is supported by the NASF.	Coordinate and involve agencies interested in Forest Service policy and strategy to develop broad constituency support.
Standardization	Focus is on the consistent use of resources, prioritization of fires, and more rigorous use of analytical tools such as the WFSA.	Calls for a more efficient national approach to large fire management. Policy interpretations need to be more consistent between partners.	Relies on a consistent approach at the Region and forest level through the delineation of highest values to be protected.
Economic Efficiency	High costs of large fires are the primary issue. Sensitivity to costs needs to be a top priority in all discussions, analysis, transitions, briefings, and oversight.	Concludes that there are no well-defined guidelines or direction that specifically lead to minimum cost strategies or tactics.	Addressed broadly in watershed protection, species conservation, public safety, and directly in regional assessments.
Wildland-Urban Interface	The NFMAS process does not include costs associated with the protection of the wildland-urban interface adjacent to the National Forest. We do not budget for more than wildland fire protection, yet we must strive to protect the wildland-urban interface if the action calls for it.	Will be addressed during implementation and planning for large incident management with greater emphasis for more effective solutions depending on specific roles.	Directs treatments to highest values to be protected, specifically addressing human communities.
Administration and Employee's Roles	Adequate resources and the right type of resources is a critical concern. An aging workforce will make this an extreme situation in the very near future. The current "militia" approach is limiting.	The "militia" approach for extended attack and large fire support is limiting. A separate organization for large incident management is needed.	Fire protection capabilities must be maintained in order to sustain ecosystems, and keep treatment options open.

Foreword

In late summer of 1999, lightning would strike Northern and Southern California and begin a three-month odyssey of fire fighting that would eventually consume over 227,000 acres and cost about \$178 million to finally contain. Over the last twenty years the average annual expenditure for emergency fire suppression, in current dollars, has been about \$304 million.

On August 23, 1999, a lightning strike started fires in Northern California on the Shasta-Trinity National Forest, about 28 miles northwest of Weaverville. Five major fires collectively known as the Big Bar Complex would eventually burn 140,907 acres and cost about \$81 million to suppress.

A few weeks after the beginning of the Big Bar Complex, on September 8th, a similar lightning storm would start several fires in and near the Ventana Wilderness on the Los Padres National Forest in Southern California, about 20 miles south of Carmel. Two and one-half months later, after 86,700 acres burned and almost \$97 million expended, the Kirk Complex would be contained.

A variety of fire management strategies were developed for these Complexes. However, terrain, limited access, and hot, dry weather made firefighting extremely hazardous. Concern for firefighter safety was always paramount. Indications were from the very beginning that containment of these two incidents would take much longer than normal.

Both of these California fires have since had cost reviews from national and regional teams. While the reviews have documented incremental and valid reasons for the high costs, broader contextual issues suggested a more in-depth and rigorous examination of these two incidents. Accordingly, a team was established to conduct this examination.

The Team

The team consists of the following members:

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The Team's Charter

The charter of the team:

- To determine if there are any underlying, unaddressed causes for the high costs associated with the Kirk and Big Bar Complexes.
- To assess the validity and practicality of remedies, if any, and suggest alternative actions with the explicit goal of reducing suppression costs without compromising firefighter safety.
- To use these two examples, in general, to draw conclusions about large fire management and associated costs and outline recommendations to adjust policies and program direction, as needed.

Introduction

Fighting wildland fires is a dangerous, expensive business and getting more so as we are confronted with today's complex set of environmental, social, political, and safety concerns. There is no lack of logical recommendations on how to control costs on large fires. In fact, over the last five years or so, the USDA Forest Service and others have produced many well-written reports that outline over 100 ways to improve large-scale fire management, including cost-efficiencies (see Appendix B for listing of references used). However, the management of fire is not limited to logic. Changes in a number of factors, including weather, access, dangerous terrain, available resources, the skill level of fire fighters, and a wide-range of social and economic concerns can transform the best fire management strategy ever produced by a Wildland Fire Situation Analysis into an afterthought. If the logic of a confine and contain or more indirect strategy fails, additional property is lost and ultimately, people may die. Accordingly, many have concluded that fighting fire is extremely risky business. Some have also concluded that the USDA Forest Service is a risk-averse organization. However, when a home is destroyed and people perish because a "well-analyzed" fire strategy goes awry, how do we explain the "logic"? Clearly we cannot, at least not to the satisfaction of those directly affected.

The USDA Forest Service has the premier wildland fire management program in the world. During the 1990's, many forces like the ones just mentioned have combined to make the efficient and cost-effective protection of lives and property from wildland fires an extremely complicated and costly process. The work of the agency in this regard continues to excel, but improvements are required if we want to succeed in the future.

Some conclude that the culture associated with emergency funding for fire suppression lacks the rigor, discipline, and incentives for more efficient decision-making. While this may be true in some incidents, this represents only the tip of a much larger and more complex problem. Some of the facets of the problem include:

- Changes in ecosystems from 100 years of reasonably successful fire suppression, leading to large expanses of heavy fuel loading.
- Increased human movement into wildlands, producing a larger wildland/urban interface.
- Reductions in budgets and subsequent reductions in workforce and equipment for all aspects of fire prevention, presuppression, and suppression, including the general availability of all personnel.

It is clear that sometimes only a small part of the problem is within the control of an Incident Management Team or the Forest on which a fire occurs, especially after the beginning of a fire.

In 1995, a report by the agency entitled "Fire Economics Assessment Report" concluded that "the forces tending to increase costs (of fire suppression) will greatly outweigh those tending to reduce costs, and only major changes in fire management policy can change this outcome". A more

recent report by the General Accounting Office (GAO/RCED-99-65) stated “outside experts and USDA Forest Service officials generally agree that increased fire suppression efforts will not be successful because such inevitable, large, intense wildfires are generally impossible for firefighters to stop and are only extinguished by rainfall or when there is no more material to burn”. The focus of this report was the need for aggressive fuels management. Another conclusion by the most current report on fire program policy says, “without a fundamental change in the way large fires are managed, we can expect to experience the problems of today well into the future (An Agency Strategy for Fire Management, 1999, USDA Forest Service)”. This report deals, in part, with fire preparedness.

Spending \$178 million on two fire complexes cannot be taken lightly. These two Complexes accounted for about 30 percent of the total USDA Forest Service fire suppression expenditures in 1999 and represents about 60 percent of the average annual fire suppression costs over the past twenty years. Controlling costs has to be a vital concern to the agency; it needs to be a predominate message. Being sensitive to budgeting for fire suppression and keeping expenditures within planned budgets needs to be a top priority and integral to fire management decision-making.

This strategic overview in no way intends to take away from a legacy of outstanding performance by the fire management community. Our hope is this team can develop some added guidance, using the Big Bar and Kirk Complexes as examples, that will help the agency become even better in its goal of reducing the threat and impacts of wildfires in ways that are safe, cost-effective, and in balance with a wide range of values.

A Synopsis of the Big Bar and Kirk Complexes

The following provides a synopsis of what happened on these two fire Complexes.

The Big Bar Complex

On August 23, a severe dry lightning storm ignited dozens of wildland fires over northern California. The area is characterized by timber with a brush understory. Within days, nearly 300 fires were burning over 19,000 acres. Five of these fires sparked the beginning of what would become known as the Big Bar Complex. After 91 days, the Big Bar Complex was contained at 140,907 acres.

Much of the fire burned in rugged, steep terrain and a roadless/wilderness area, limiting suppression tactics and increasing the fire's duration, acres burned, and the complexity of the fire. Because of smoke inversions and dangerous terrain, firefighter safety priorities precluded the use of direct attack in many instances. Extremely dry conditions with high-energy release components and heavy fuel loads resulted in extreme fire behavior that necessitated firefighter retreats and changes in tactics.

The Big Bar Complex included five major fires -- the Onion, Fawn, Megram, Dees, and Soldier – and in terms of priority for resources, at least during the beginning stages, was ranked last out of eight fires in northern California. Resource orders were assigned based on these priorities. The criteria for ranking include:

- Potential to destroy life, improvements, and property
- Potential for long-term natural resource loss (e.g., watershed, timber)
- Potential for short-term natural resource loss (e.g., grazing, crops)
- Containment difficulty (e.g., difficult terrain)

Because all but one of the complex fires were within the Trinity Alps Wilderness, other fires in the state received higher rankings and therefore out-competed the Big Bar Complex for

resources. Issues involving tribal relationships with the Hoopa Valley Indian Reservation, that were identified early on, would later surface as critical concerns.

Another major factor contributing to the duration, cost, and size of the Big Bar Complex was the necessity of using indirect attack to maintain safety of the limited crews who were available for the fire. Repeated instances of using indirect attack extended the duration of the fire and the acreage burned, but did maintain a strong commitment to firefighter safety.

The results of the low priority ranking and limited resource availability became apparent quickly. For example, by August 28, only eight of the 17 Type I crews ordered had arrived. During the first ten days orders were placed for a total of 34 crews, and 16 of those went unfilled. In the last days of August, 20 type II crews were ordered; 10 of the crews arrived on the first of September.

Active uphill “fire runs” were noted on August 28th. A “red flag” watch was issued for high winds the next day. By then the fires had grown to over 9,000 acres. The Onion Fire had burned to within a mile of Hoboken, fuel moistures were extremely low, and other fires were moving in all directions. There were still no personnel available for the Megram Fire, which by September 3rd was almost 400 acres. The Fawn Fire had burned to within a mile of heavy blowdown, and the Onion Fire was within a half mile of the Dailey subdivision. Smoke was settling over the area, and aircraft use was limited.

Air operations were suspended on the Onion Fire on September 7th because of continued smoke inversions. More than 1,100 people were now on the 17,542-acre complex. Heavy smoke inversions continued to limit suppression options. Hot and dry conditions continued, with active fire behavior. By September 17th the fire complex had grown to 42,436 acres.

With the fire at 60,716 acres on September 25th, a fire weather watch for winds was issued, and the fire burned into a forest blowdown area. The next day a red flag warning was issued for gusty winds, dry fuels, and low humidity. Firefighter safety and defensible positions were stressed. However, by then temperatures were in the 90’s and major “fire runs”, with one-mile forward spotting, had pushed the fire to over 80,000 acres by the end of the month.

By October 13th, after another week of dominant high pressure, a fire weather watch was issued for gusty winds, low relative humidity, and temperatures in the 70’s. The fire, at 110,069 acres, was still under an inversion. Red flag warnings continued for the next several days, with 25 mile per hour wind gusts and temperatures in the 70’s. By the end of the following week the fire had reached 127,702 acres. There were still about 6,600 feet of line to build on October 26th, with 3,331 people on the fire. At 136,765 acres, the fire received some drizzle from a passing cold front. Heavy demobilization began on October 28th, with lingering showers and near-freezing night temperatures slowing the fire activity. By the first of November, 160 miles of fire line was in place, with only 1,500 feet of line remaining to be built. The fire was declared contained on the evening of November 3rd, with a chance of rain predicted. Burned area emergency rehabilitation efforts were under way.

Twelve years ago the Silver Fire on the Siskiyou National Forest, just north of the Big Bar Complex, ran 72 days and burned 97,000 acres. These two campaign fires had several elements in common:

- Initial low priority ranking
- Fire weather
- Shortage of initial attack resources
- Inability of fire management agencies to field an adequate suppression response at peak demand
- Inaccessible terrain and heavy smoke problems forcing indirect attack

- Focus on protection of private property, dwellings, and communities at the expense of natural resources on the National Forests

The property and resources saved through the suppression efforts on the Big Bar Complex included the towns of Denny and Hawkins Bar, portions of the Hoopa Valley Indian Reservation, almost 200 homes, watersheds, and timber.

The Kirk Complex

On September 8, 1999, a lightning storm ignited thirteen wildfires within and adjacent to the Monterey Ranger District, Los Padres National Forest, Southern California. The majority of the fires were within the Ventana Wilderness. Mixed chaparral, chamise, pine, and hardwood forests in the uplands and redwoods and hardwoods dominating the canyon bottoms characterize the area. By the end of November 1999, the Kirk Complex was contained at 86,700 acres. In August 1977, a similar storm system ignited the Marble Cone Fire within the Ventana Wilderness burning over 177,000 acres. Over the past 22 years, numerous smaller wildfires have burned in the Ventana Wilderness.

The Kirk Complex was an expensive operation for a variety of reasons. There is an estimated four times the number of homes surrounding the Marble Cone area than in 1977. The close proximity of homes to the forest boundaries required larger numbers of aircraft and personnel to provide for safety and protection of private property. Other cost contributors included heavy fuel buildup; an unusually dry, hot, windy fall fire season; the need to use many non-federal fire suppression resources; and, the need to use expensive heavy helicopters due to limited access into the Ventana Wilderness.

The Wildland Fire Situation Analysis (WFSA) served as the overall strategic planning tool for the Kirk Complex. This process measures anticipated suppression costs in addition to resource losses and determines the safest alternative with the highest probability for success. The WFSA was executed on September 9, 1999 and revised on September 29th. The revision was prepared when it became clear the initial strategy of direct attack on the fire was not effective because of extreme fire behavior. The remote location of the fires and limited access were causes for concern over firefighter safety.

Four alternatives were considered in the WFSA on the Kirk Complex. The indirect attack alternative was selected. This alternative had the highest predicted success outcome while calling for:

- Firefighter safety
- Minimized environmental impacts
- Minimized economic impacts
- Maintained social/public information networks

The widespread geographical area of the Kirk Complex, coupled with extreme fire behavior in steep terrain, demanded a large logistical operation to support the suppression effort. Fire behavior modeling indicated an aggressive fire suppression operation was required to keep the fire from escaping established fire lines and burning onto private property.

Without large-scale suppression efforts, these fires would have resulted in serious long-term detrimental affects on human life and private/public property, including municipal water storage capacities. The authorization of bulldozer use in the Ventana Wilderness prevented the wildfires from moving freely throughout the Santa Lucia mountain range and threatening the communities of Big Sur, Palo Colorado Canyon, Chews Ridge, Cachagua, Carmel Valley, and Arroyo Seco. The use of heavy helicopters and airtankers effectively slowed the spread of active fire fronts and allowed firefighters to aggressively attack the flanks of the fire. Without these aggressive suppression responses, the wildfires had the potential to burn west

to the Pacific Ocean, north and east to the agricultural lands of the Salinas Valley, and south to areas previously burned on Fort Hunter Liggett Military Reservation.

The Land Management Plan for the Los Padres National Forest authorizes the use of prescribed fire in wilderness but states that lightning-caused fires, such as on the Kirk Complex, must be suppressed. A valuable lesson learned from the Kirk Complex is the need for better modern fire management planning. The Forest intends to examine the wilderness fire management strategies in its current Land Management Plan and proceed with development of a Fire Management Plan that addresses the use of both prescribed fire and wildland fire in wilderness areas.

The resources saved by suppression efforts on the Kirk Complex were valued at about \$400 million ("Kirk Complex, Los Padres National Forest, Loss and Savings Estimates", November 1999) including several homes, municipal watersheds, endangered species habitat, recreation resources critical to the local economy, and the protection of slopes above Highway 1 that could have closed this major highway because of potential mudslides.

Epilogue

There are several measures of fire suppression cost efficiency. These include total emergency fire suppression, total cost plus net value change, total cost per acre, and total cost plus savings. As an organization, we have not yet agreed to a true measure to illustrate cost efficiency. On each large incident we report savings as well as costs. The Incident Commander or general staff approves the method of calculating savings. Methods vary and results can be questionable. Agreeing on which cost and savings measures illustrate the true picture of fire suppression cost efficiency is critical.

Firefighter safety on the Kirk and Big Bar Complexes was always ranked as the top priority ahead of fire suppression. While the fire management agencies will not compromise firefighter safety in favor of an overly aggressive suppression tactic, some of the other actions that influence overall strategy effectiveness are more controllable. Increasing our initial attack resources, reconsidering our criteria for prioritizing fires in a multiple-fire situation, and exploring all options for expanding fire resources are actions that will have direct positive impacts on our fire management effectiveness in both the short term and the long term.

Cost Categories in Fire Suppression

In general, fire suppression costs are grouped into four major categories with the percentage of national expenditures over the last 20 years (reference) shown in parenthesis. These are:

- Supplies and services (56 %)
- Personnel compensation (32 %)
- Personnel travel (3%)
- Other (9 %)

Forest records indicate that the expenditures for the Big Bar and Kirk Complexes were generally consistent with the national percentages for fire suppression except for some differences (increases) in "personnel compensation". This was probably due to the high number of interagency personnel used on the two Complexes.

Several factors cause fire suppression expenses to increase. In a survey of 103 Incident Commanders (IC's) on 84 fires, 34 topics, or activities were evaluated in terms of their effect on increasing suppression expenses (Fire Economics Assessment Report, September 1, 1995, USDA Forest Service). The following were the top ranked items:

1. Weather
2. Access
3. Terrain
4. Protecting lives
5. Line-officer direction (Forest Supervisor and District Ranger)
6. Firefighter availability
7. Fire suppression standards
8. Fuel loadings
9. Firefighter quality
10. Firefighter quantity
11. Protecting structures
12. Support personnel availability
13. Wildland-urban interface
14. Publicity and notoriety
15. Recreational and esthetic values
16. Equipment availability

All of these items played heavily in the fire suppression costs associated with the Big Bar and Kirk Complexes, especially weather, access, terrain, firefighter availability, protecting structures, and fuel loadings.

In the Kirk Complex, the following added significantly to the suppression costs:

- Close proximity of homes to the forest boundaries requiring more aircraft and personnel to assure the safety of private property.
- Heavy fuel buildup.
- Unusually dry, hot, windy fall fire season with intense fire behavior.
- The use of more expensive non-federal fire suppression resources.
- The use of more expensive heavy helicopters due to limited access into the Ventana Wilderness.

In the Big Bar Complex, the following contributed to the suppression costs:

- Heavy fuel buildup.
- Protecting the Hoopa Indian Reservation and the town of Denny.
- Weather and extreme fire behavior.

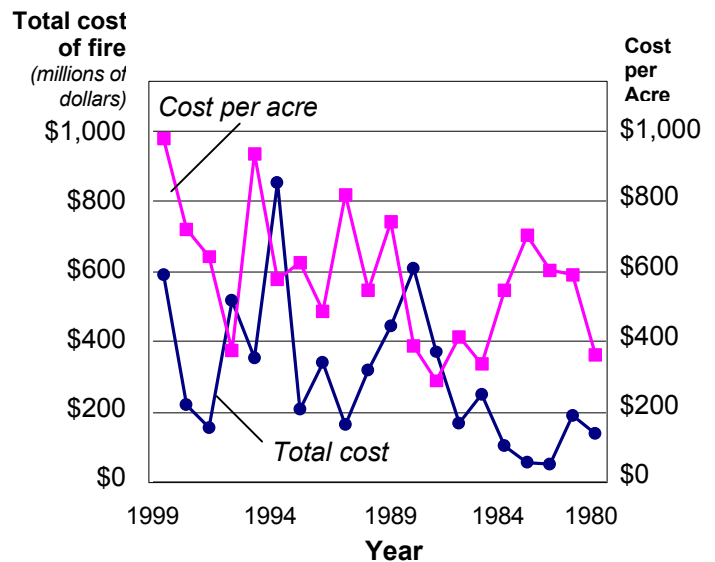
National Expenditures for Emergency Fire Suppression

During the past twenty years, over \$6 billion has been spent on emergency fire suppression at an average rate of about \$304 million per year (expressed in terms of 1999 dollars). The highest single year was 1994 when \$850 million was spent on 1,476,000 acres. The lowest year was in 1982 when \$50 million was expended.

Table 2. National Expenditures for Emergency Fire Suppression, 1980 through 1999, USDA Forest Service.

Year	Costs ¹	Acres Burned	Average \$/Acre
1999	\$591,000,000	605,000	\$976.86
1998	219,300,000	306,000	716.67
1997	154,246,960	241,000	640.03
1996	514,153,200	1,367,000	376.12
1995	350,635,608	376,000	932.54
1994	849,987,396	1,476,000	575.87
1993	205,616,119	330,000	623.08
1992	340,802,589	699,000	487.56
1991	163,741,389	200,000	818.71
1990	319,088,563	585,000	545.45
1989	442,166,330	597,000	740.65
1988	604,357,759	1,556,000	388.40
1987	368,538,256	1,281,000	287.70
1986	167,696,327	406,000	413.05
1985	249,250,324	741,000	336.37
1984	102,490,769	187,000	548.08
1983	56,711,069	81,000	700.14
1982	50,128,049	83,000	603.95
1981	191,011,998	325,000	587.73
1980	136,767,256	379,000	360.86
Totals	\$6,077,689,961	11,821,000	--
Average	\$ 303,884,498	591,050	\$582.99

¹All costs expressed in terms of 1999 dollars.



There is extreme variation across the years in acres burned. The ratio of high to low is on the order of 20:1. Though the 20-year average is 591,050 there are only two years (1989 and 1990) that are within 10 percent of the average. There are only 4 years that are within 20 percent of the average. Accordingly, the variance in acres burned in each year is more important than the actual number in each year. Perhaps oddly the 1994 season, which is often cited as a key “policy-change” year, does not stand out in the table as unusual with respect to acres. Although it is the highest cost year, it does not have the most acres burned and the average dollar per acre is very near the 20-year average.

The average dollar per acre (\$583) is not readily accounted for by the number of acres burned. For example, 1998, 1995, 1993, 1981, and 1980 all had a similar number of acres burned, ranging from 306,000 acres to 379,000 acres. Yet, in those years, the dollar per acre ranged from a low of \$360 to a high of \$932; almost a 3:1 ratio.

The average fire suppression cost per acre for the Big Bar Complex was \$575, while the cost per acre for the Kirk Complex was \$1,118. For both Complexes combined, the average cost per acre was approximately \$784 (weighted by the number of acres burned in each complex). On a comparative basis, neither the Big Bar nor the Kirk Complex is drastically out of line with historical averages. Though the Kirk Complex cost at \$1,118 per acre is higher than the average acre cost in any one year, it is only slightly higher than the cost per acre for 1999 (\$976). In general, it is difficult to compare fires on a cost per acre basis with national averages, because such averages include fires that vary greatly in size, terrain, access, weather, and competition for resources. Small fires are much more expensive on a per acre basis than are large fires, creating a potential distortion in per acre cost comparisons.

Making comparisons of the Big Bar and Kirk Complexes on a suppression cost per acre basis with historical fire suppression costs tends to lead to a conclusion that these fires were not unusual. However, this result is an artifact of using per acre costs as a basis for identifying and characterizing fires as in some way noteworthy and/or costly. While both the Big Bar and the Kirk Complexes compare well on a cost per acre basis with historical averages, the combined suppression cost of \$178 million and the length of time it took to control these Complexes is what made them significant.

The findings will show that opportunities to reduce costs on the two Complexes could have been improved through:

- Improved initial attack.
- Clear evaluation of watershed scale fire management strategies in Forest Land and Resource Management Plans and associated Fire Management Plans.
- Improved use of the Wildland Fire Situation Analysis process.
- Improved integration of risk analysis in fire management decisions.
- Additional oversight, including the continued message that striving to keep costs reasonable is a priority.

Focus Questions

To help evaluate what happened on the Big Bar and Kirk Complexes, and in particular to reexamine the cost issue, the following are the focus questions, by groupings, that accompanied our task from the Deputy Chief, State and Private Forestry.

Decision-making processes:

- Are line officer decisions affecting the cost of suppression, either increasing or reducing the final bill?
- Are resource management decisions/directions affecting costs?
- What are these decisions and how are they affecting costs?
- Did any decisions affect fireline safety? How?
- Is the line officer fully involved in providing direction to the incident management team or are his or her responsibilities delegated?

Suppression alternatives:

- Are trade-offs being analyzed?
- If this is a low or lower priority fire competing for short resources, has there been consideration given to a low or lower cost option?
- Is the risk of doing as little and as safely as possible evaluated?
- Are new alternatives considered after several days of no significant change in the status of the fire?

Costs:

- Are the decisions that are affecting costs documented?
- How are they being documented?
- Were costs affecting decisions challenged?
- Were costs factors explicitly discussed?
- Were minimum cost options considered? How?
- To what extent has mobilization affected the cost of this fire?
- Is it (the cost) worth it when the outcome is not materially changed?
- Were high cost items specifically examined for cost-effectiveness and the marginal change to the fire's outcome?

Resource levels, skills, and agency commitment:

- What is the level of local commitment to this fire (the Kirk and Big Bar Complexes)?
- How many people from the Forest were engaged in this fire?
- Are Forest personnel assigned fire management responsibilities fully qualified?

The team subsequently distilled a set of interview questions, and then interviewed the Forest Supervisors and staff from the Los Padres, Shasta-Trinity, and Six Rivers National Forests. The results of the interview are included in Appendix A.

Literature Review

During the last several years the USDA Forest Service and others have produced many well-written reports that outline many ways to improve large-scale fire management that specifically address cost-efficiencies. Appendices C through I analyze some selected literature and compare their findings against the two complexes being examined. The following review of the literature helps establish a foundation for the current fire management program and sets the stage for program adjustments.

Confronted with today's complex set of environmental, social, political, and safety concerns, fighting fires is a complex business. Catastrophic wildfire now threatens millions of public and private wildland acres, particularly where vegetation patterns have been altered by past land-use practices and a century of fire suppression. According to the recent report by the General Accounting Office, the most extensive and serious problem related to the health of forests in the interior West is the over accumulation of vegetation, which has caused an increasing number of large, intense, uncontrollable, and catastrophically destructive wildfires. Further the report concludes that the cost of burning and mechanical removal of excessive fuel on 39 million acres of National Forest System lands at high risk is estimated to be about \$725 million a year. For FY 1999, the USDA Forest Service requested and received \$65 million to reduce accumulated fuels (GAO/RCED-99-65).

Outside experts and USDA Forest Service officials generally agree that increased fire suppression efforts will not be successful because such inevitable, large, intense wildfires are generally impossible for firefighters to stop and are only extinguished by rainfall or when there is no more material to burn. Many agency officials believe it is impossible to set controlled fires to reduce fuels on a scale replicating that of natural fires and still meet air quality standards or even more basic to control the fires. Regardless, a cohesive strategy is not yet in place to address the issue of reducing excessive forest fuels (GAO/RCED-99-65).

To address the issue of excessive forest fuel, the USDA Forest Service has produced a report entitled "Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy (Draft Report, December 3, 1999)." The strategy calls for an aggressive approach to fuels management through prescribed fire and mechanical treatments. Funding requirements are \$825 million by 2004 – about \$137 million is required in 2001. Fire professionals now feel that fuel buildup has allowed fires to turn the corner on fire suppression capability and that large fires of the recent past are indeed fires of the future (Large Fire Strategy, Committee Report, May 1996, USDA Forest Service). Without an aggressive fuels management program, we face an impossible situation to protect lives, property, and natural resources from wildland fires.

In addition to a higher than normal fuel buildup, the Forest Service's fire preparedness and the ability to initial attack fires is beginning to be compromised. The National Fire Management Analysis System (NFMAS) is an outyear planning tool used to define the benefit cost ratio of dollars spent for fire preparedness versus the fire suppression costs plus the value of the natural

resources lost in a fire. The optimum point in this model is referred to as the Most Efficient Level, or MEL. The NFMAS model displays the tradeoffs between an amount of appropriated funds for firefighting resources such as helicopters, crews, engines, compared to the cost of fire suppression, plus the number and value of acres and natural resources lost at each appropriated fund level. This appropriated funding level is displayed as a percent of MEL; the tradeoff is displayed as a change in dollar value of burned natural resources, and the number of acres burned. Estimates have shown that for every dollar of appropriated preparedness dollars received, there is a savings of five to seven dollars in fire suppression and emergency rehabilitation funds spent.

Over the last 10 years, the operational level of appropriated funds, or percent of MEL, has decreased – from 89 percent in FY 1990 to 75 percent in FY 2000. This has resulted in a reduction in the number and types of firefighting resources available for initial attack. However, wildland firefighting agencies (or the Administration or Congress) appear to be reluctant to adequately fund initial attack resources or prevention efforts (NASF Report on Efficient Utilization of Forest Fire Suppression Resources, September 17, 1999, National Association of State Foresters). This may be partially due to low awareness, or even apathy, about fire management by those who make program, budget formulation, and funding decisions. Historically, the USDA Forest Service has been able to extinguish most wildfires during initial attack. However, there is a general lack of overall recognition that we are now in an era of diminished suppression capability and increased concern for firefighter safety and high fire suppression costs (Large Fire Strategy, Committee Report, May 1996, USDA Forest Service).

Current direction for planning wildfire suppression strategies during a fire correctly prioritizes the protection of life above protecting private property and natural resources. Wildland fire suppression forces protect urban values over forest ecosystem values. The result is often greater acreages of burned wildlands (Course to the Future: Positioning Fire and Aviation Management, May 1995, USDA Forest Service). This further constricts available funds.

A very serious problem is developing. Fires have become more difficult to control and the overall wildland fire suppression capability has decreased. During heavy fire seasons, there are simply not enough critical resources to meet demand (Large Fire Strategy, Committee Report, May 1996, USDA Forest Service). This combined with an aging workforce and a fire management cadre that is smaller and less experienced than in the past puts the agency at a critical juncture (GAO/RCED-99-233). To proceed effectively, some adjustments need to be made.

To help bring focus to this, the agency commissioned a report entitled, “An Agency Strategy For Fire Management, (Draft Report, November 15, 1999, USDA Forest Service)”. While still in a draft status, the report recommends a “pathway” to create a separate large incident management option. This option defines a national incident management organization dedicated to large fire suppression and total integrated wildland fire management programs. The current approach to initial and extended attack would remain the same.

Managing a large incident effectively and efficiently requires leadership, skill, analytical tools, resources, decent weather and terrain, and luck. The initial strategic decision regarding fire suppression is the most important and contributes significantly to the costs associated with large fires (Large Fire Strategy, Committee Report, May 1996, USDA Forest Service). When the Incident Management Team arrives to take over the management of the incident, Forest leadership must stay appropriately engaged in the process. The Delegation of Authority letter is a contract between the Forest Supervisor and Incident Commander that ensures all fire suppression actions are managed in a safe and efficient manner. However, the overall responsibility and accountability for the incident rests with the line officer. Training line officers to better redeem their fire management responsibilities is vital (Course to the Future: Positioning Fire and Aviation

Management, May 1995, USDA Forest Service). Oversight at all levels is important (Memorandum, Fire and Aviation Management, State and Private Forestry, August 27, 1999).

The Wildland Fire Situation Analysis (WFSA) provides options to suppress the fire. Some people question the utility of the WFSA process. Some consider it only a communications tool, while others find it useful for documenting decisions. It does seem that only a few use its full potential to display the tradeoff between cost and risk (Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season, August 1, 1995, USDA Forest Service). However, it is generally concluded that the WFSA is an essential tool to be used if suppression tactics are to be most effective and cost-efficient. The analytical components of the WFSA need be expanded to better reflect issues associated with the wildland-urban interface (Fire Economics Assessment Report, September 1, 1995, USDA Forest Service).

Costs for fire suppression, especially those associated with large fires, continue to climb. Only a few factors that lead to high costs are within the control of an Incident Management Team or a National Forest once a fire starts. During a large fire, the Incident Management Team and the Forest management team must quickly make decisions balancing the trade offs between cost and such factors as safety, risk to homes and other property, long term effects on critical watersheds, and so on. The negative after effects of burning homes on adjacent private lands are greater than the negative after effects of being a high cost fire. This will continue to lead decision makers to request and retain fire fighting resources to deal with the most likely scenario or the worst case scenario rather than the best case scenario. For example, Incident Commanders are sometimes reluctant to release air resources, even when the resources may not be immediately needed, for fear that these resources will not be available if conditions on the fire deteriorate (Large Fire Strategy, Committee Report, May 1996, USDA Forest Service).

A recent report stated that the USDA Forest Service manages emergency firefighting funds as unbudgeted, unlimited, unallocated, and without benchmarks on acceptable spending levels and concluded there is an appearance of low accountability. Further, least costs fire suppression strategies and tactics are not a required part of the WFSA, and there are no well-defined guidelines or direction that specifically lead to minimum cost strategies and tactics (An Agency Strategy for Fire Management, Review Draft Report, November 15, 1999, USDA Forest Service).

Several well-written reports, with over 100 recommendations, have been completed over the years that address fire cost issues. The adequacy of recommendations is not the issue. Many of the recommendations will not be implemented because of policy, funding, and organizational barriers (Fire Economics Assessment Report, September 1, 1995, USDA Forest Service). As stated in "Fire on the Mountain", "so often we don't have the fortitude to go forward and seek the changes we need" (Fire on the Mountain: The True Story of the South Canyon Fire, 1999, John N. Maclean).

Some conclude that forces tending to increase costs (of fire suppression) will greatly outweigh those tending to reduce costs, and only major changes in fire management policy can change this outcome (Fire Economics Assessment Report, September 1, 1995, USDA Forest Service). Nevertheless, until this change begins to take shape, keeping costs in check must be a key discussion topic at every transition point, briefing, or oversight review (several Reviews and Memoranda from Fire and Aviation Management, State and Private Forestry, USDA Forest Service).

We are faced with a philosophical conflict. Today's large suppression costs are the direct result of effective suppression efforts over the last 100 years. On the one hand we must continue active fire suppression to protect resources at risk, including lives, property, watersheds, critical habitats. On the other hand, we have no clear strategy for reversing the effects of the last 100 years of suppression. To be truly cost effective in the future, we must get a handle on both the

over-accumulation of vegetation and on the management of suppression tactics, including a clearer understanding of organizational requirements to effectively meet program goals.

It is easy to let the long-term problem drift for another year – the added accumulation of one year to 100 years is not significant. It is also easy to focus on single large, high cost fires and say that something must be done to control their cost. It will be impossible to control costs without facing the long-term situation.

The Current Policy

In order to help evaluate the actions of the Big Bar and Kirk Complexes, comparing the tactics taken against a standard – the current policy – is important. Table 3 illustrates the current Federal Wildland Fire Management policy for the USDA Forest Service and a general rating of the relative strengths of the actions associated with these two fire Complexes toward the policy. In general, the team found that the two Complexes adhered to the national policy guidelines quite well.

Table 3. The Adherence of the Big Bar and Kirk Complexes to the National Fire Management Policy, USDA Forest Service

Key Points	Policy	Rating ²
Safety	Firefighter and public safety is the first priority. All Fire Management Plan and activities must reflect this commitment	H
Planning	Every area with burnable vegetation must have an approved Fire Management Plan.	L
Wildland Fire	Fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, across agency boundaries, and will be based on the best available science.	N/A
Use of Fire	Wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role.	N/A
Preparedness	Agencies will ensure their capability to provide safe, cost-effective fire management programs in support of land and resource management plans through appropriate planning, staffing, training, and equipment.	M
Suppression	Fires are suppressed at minimum cost, considering firefighter and public safety, benefits, and values to be protected, consistent with resources objectives.	H
Prevention	Agencies will work together and with other affected groups and individuals to prevent unauthorized ignition of wildland fires.	H
Protection Priorities	Protection priorities are (1) human life and (2) property and natural/cultural resources.	H
Interagency Cooperation	Fire management planning, preparedness, suppression, fire use, monitoring, and research will be conducted on an interagency basis with the involvement of all partners.	H
Standardization	Agencies will use compatible planning processes, funding mechanisms, training and qualification requirements, operational procedures, values to-be-protected methodologies, and public education programs for all fire management activities.	H
Economic Efficiency	Fire management programs and activities will be based on economic analyses that incorporate commodity, non-commodity, and social values.	M
Wildland-Urban Interface	The operational role of Federal agencies as a partner in the wildland-urban interface is wildland firefighting, hazard fuels reduction, cooperative prevention and education, and technical assistance. Structural fire protection is the responsibility of Tribal, State, and local governments. Federal agencies may assist with exterior structural suppression activities under formal Fire Protection Agreements that specify the mutual responsibilities of the partners, including funding.	H
Administration and Employee's Roles	Employees who are trained and certified will participate in the wildland fire program as the situation demands; employees with operational, administrative, or other skills will support the wildland fire program as needed. Administrators are responsible and will be accountable for making employees available.	M

²H (High); M (Medium); L (Low); N/A (Not Applicable)

Team Findings

The findings of this report are divided into three categories -- General themes that have surfaced; those specific to the Big Bar and Kirk Fire Complexes; and, those that have broad, national implications. The findings are as follows:

Themes

Many Federal, state, and local fire managers were interviewed about the Big Bar and Kirk Complexes and large fire management in general. Several themes, some critical of the current fire management program, have emerged. These themes help establish a foundation for the fire management program so realistic adjustments can be made. These themes include:

- The consequences of declining preparedness funding at the field level are not completely understood. For every dollar reaching the ground, there is a reduction of five to seven dollars in the cost of suppression and emergency rehabilitation, and a corresponding decrease in natural resource damage. By not funding preparedness close to the 100 percent of MEL, additional suppression and rehabilitation costs, and natural resources destroyed increase dramatically. Funding at the MEL does not mean there will be no losses, but these losses increase exponentially as funding for preparedness declines.
- Less preparedness funds are reaching the field level. There are numerous reasons including, budgeting changes, unplanned special projects, and the willingness to view suppression costs as “off-line” or “free”. The Forest Service is making budget allocation choices that indicate fire is a low priority. By diverting preparedness funds and not requesting higher funding levels closer to the MEL, we are making other investments in natural resources that we cannot protect from destructive fire. In doing so, we are essentially devaluing natural resource losses.
- Fire suppression is much more complex than ever before. An experienced fire management workforce, once the hallmark of the Forest Service, is beginning to be in question. The initial strategic decision on a fire, pivotal to successful outcome of the incident, is often delegated away by some line officers in part because they do not feel qualified to address today’s complexities of fire suppression. An aging workforce within the agency makes this experience/fire complexity dilemma even more severe in the future.
- Fire management planning has not been a priority, with less than 5 percent of the National Forests having current, approved fire plans. The agency is not in compliance with the National Fire Management Policy.
- Excessive forest fuel makes effective and efficient fire fighting almost impossible.
- The traditional “militia” approach to large fire suppression is not working. The overall reduction of Forest Service field personnel over the last decade is a primary reason. This, combined with the decreasing availability of existing personnel to participate in fire suppression activities because of low pay incentives, higher priority work, and a variety of personal reasons, will require some changes to be made if we are to remain effective.
- The current organizational climate does not encourage acceptance of levels of risk consistent with achieving greater cost efficiency, regardless of how well analyzed and documented the fire management decisions.
- Suppression alternatives, that address costs through the WFSA, need improvement.
- The need to keep costs as low as practicable is not a predominant message during a fire incident.
- Fire management should be one of the agency’s top Policy Issue Areas. Currently it is mentioned only tangentially to issues associated with ecosystem health.

Big Bar and Kirk Fire Complexes Findings

Neither comprehensive interviews of the leadership of the involved National Forests, or discussions with a wide range of Federal, state, and local fire managers, or our analysis of the initial review of the incident (National Large Incident Cost Oversight Report, September 30, 1999), identified anything that would have *significantly* reduced the costs of managing the Big Bar and Kirk Complexes. We did however, highlight a number of factors that contributed to the overall costs and believe the identification of these can provide opportunities for future efficiencies if similar incidents are encountered. These contributing factors for the two Complexes are organized by the same groupings used in the Executive Summary.

Factors inherent in the location or nature of the work include:

- Continued hot dry weather with little or no humidity recovery at night had a significant effect on fire behavior, acres burned, and suppression difficulties.
- Multiple fires across the Region meant that both complexes were competing for resources that were already in short supply – especially crews and overhead – and thus increased both the time necessary to staff the fires and also the costs of doing so.
- Because of repeated and severe inversions on the Big Bar, aircraft could be used only for a two or three-hour period each day. The inability to accurately scout fire perimeter and hotspots and thus effectively plan operations contributed to increased costs, more resource loss, and increased risk for firefighters and the public.
- A significant amount of both Complexes were in Wilderness. Limited suppression tactics were planned to minimize long-term impacts.

Factors that require long-term strategies and significant investments to resolve:

- Limited access to the fires, along with extremely steep terrain, resulted in slow progress in containment efforts and repeated loss of completed fire line.
- Vegetation on the Kirk was so thick that retardant did not penetrate in several areas. Type I helicopters were used instead of fixed-wing air tankers in order to penetrate the canopy.
- Red-carded agency personnel did not participate and/or were not made available. In some instances, there were simply shortages of qualified resources. Accordingly, the majority of personnel on both these Complexes were state and local firefighters, and the higher cost of state and local personnel increased costs on these fires. On the North Kirk Fire, for example, the use of local and state overhead rather than Forest Service employees resulted in an increased fire cost of about \$13 million.
- Blowdown of several thousand acres on the Six Rivers National Forest occurred in 1996. This was not salvaged through logging. When the fire reached that area, its rapid rate of spread and the fuel loadings resulted in added cost to the suppression effort and increased risk to firefighters.
- Over the last few years we have experienced a significant reduction of initial attack resources. For example, the Shasta-Trinity went from 27 to 18 engines; the Los Padres has gone from 25 engines to 16, five helicopters to one, and two hotshot crews to one. Some believe this trend has reduced the Forests' ability to contain single fires during the first burning period, let alone multiple simultaneous fires. During this same period, the Los Padres has also experienced a 50 percent increase in burned acres, the population of the state has increased, and the wildland-urban interface has grown significantly.
- The shortage of Type I crews and the lack of performance of Type II crews resulted in the necessity of using indirect attack more often than would have been efficient. This resulted in both increased acreage loss and increased suppression costs.

Factors with potential to improve efficiencies in the short run:

- Because of the complexities of Tribal issues and relationships with the Bureau of Indian Affairs, a significant part of Incident Commander's time was diverted from the main job of fire management.
- Present contracts do not allow for reduced costs for long-duration events. Full daily rates over a long period resulted in our paying the equivalent of the full price of some equipment -- such as cars, trucks, and so on.
- Infrared capability by aircraft was not readily available for the Kirk Complex. This necessitated the use of indirect tactics in order to maintain crew safety, and resulted in diminished suppression effectiveness, unnecessary delays, and increases in both resource loss and suppression costs.

Factors under the control of a Line Officer/Incident Management Team:

- Because the safety of fire personnel and the public was the number one priority on fires, and because of the factors cited above (combined with difficulty in obtaining ordered resources), indirect attack became the overall strategy on both fires. This was necessary and prudent to maintain firefighter safety, and resulted in increased costs and decreased suppression effectiveness. This does not infer that all indirect strategies are inefficient.
- Lack of understanding of WFSA and participation by teams and line officers on the Big Bar may have resulted in increased costs.
- The use of Minimum Impact Suppression Techniques (MIST) that were required by the Land Management Plan resulted in increased costs.
- The Incident Business Advisor (IBA) on the Kirk could have been assigned throughout the incident.

National Findings

The following are national issues identified that need to be more fully addressed in order to help the agency achieve its goal of reducing the threat and impacts of wildfires in ways that are safe, cost-effective, and in balance with a wide range of values.

Preparedness

The National Fire Management Analysis System (NFMAS) is a tool to help determine the most efficient level (MEL) for the fire management program. The MEL displays the tradeoffs between the dollars spent on fire preparedness versus the fire suppression costs, plus the change in value of the natural resources burned.

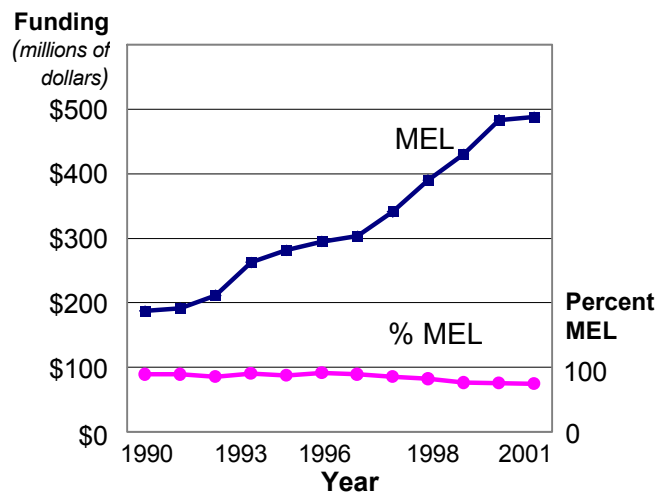
One critical component of the NFMAS model and the determination of MEL is Net Value Change (NVC). The Net Value Change is the dollar difference between the natural resources before and after a fire. Two other components of the NFMAS model are costs of fire preparedness and the cost of fire suppression. The NFMAS model optimizes the appropriated dollars spent on fire preparedness versus the costs of fire suppression plus the value of the natural resource after it has been burned. The number of acres burned is also displayed at each appropriated funding level.

Appropriated funds for the fire management program are typically referred to as a percent of MEL. For example, in FY 1999, the USDA Forest Service was funded at "75 percent of MEL". In FY 2000, funding levels for the fire management program are expected to be 74 percent of MEL. Additional indirect costs in FY 2000 may require this funding level to be reduced even further *at the field level* – perhaps to about one-half of the MEL. If this happened, one projected impact includes an increase of fire suppression costs of approximately \$600 million.

The NFMAS process only considers lands for which the Forest Service has direct fire protection responsibilities; costs associated with protecting non-Federal lands, including protecting the wildland/urban interface from a fire originating on a national forest, are not incorporated into the NFMAS model. The cost of protecting these values and the urban interface can be significant in some areas.

This fact goes right to the heart of preparedness levels for initial attack and extended attack to control fires. If the fire management program is expected to manage for events that include the wildland-urban interface, then funding levels need to be planned with this in mind. Funding at “75 percent of MEL”, with no provisions for wildland-urban interface fire protection, almost guarantees inadequate resources, inefficiencies and ultimately, excessive costs. The following table illustrates the MEL funding for the last ten years (in millions of dollars).

Fiscal Year	MEL	Actual Funding	% of the MEL
1990	\$187.3	\$167.3	89.3
1991	191.7	171.5	89.4
1992	211.8	179.8	84.9
1993	262.7	235.3	89.5
1994	281.5	245.0	87.0
1995	295.0	268.7	91.0
1996	303.5	270.8	89.2
1997	341.0	290.2	85.1
1998	390.0	319.3	81.8
1999	430.0	324.9	75.5
2000	483.0	360.0	74.5
2001 ³	\$488.0	\$355.0	72.7



³ Proposed “Actual Funding”;
Dollars are constant.

Improved state fire assistance, including assistance to volunteer fire departments, is an effective way to reduce the overall involvement of the Federal government in the wildland-urban interface adjacent to the National Forest boundary. The Cooperative Fire Management program, within the State and Private Forestry mission area, provides for a Federal role to help state and local governments become better trained and equipped to fight fires and redeem their state responsibilities. However, the program is under funded by about 60 percent.

A higher level of funding for initial and extended attack on the National Forests, coupled with an emphasized state assistance Federal role, including additional emphasis to the rural volunteer fire departments, would begin to effectively address the urgent need to deal with wildfire in America’s wildland-urban interface zones.

A cohesive, long-term budget strategy needs to be developed that includes preparedness, emergency suppression, fuels management, and state fire assistance in order to implement an effective, cost-efficient fire management program. An example budget strategy might look like this (dollars in millions):

Item	Current	Year 1	Year 2	Year 4	Year 15
Preparedness	\$360	\$480	\$500	\$420	\$325
Suppression	590	590	590	300	200
Fuel Management	65	100	135	825	135
State Fire Assistance	24	50	65	65	65
Totals	\$1,039	\$1,220	\$1,290	\$1,610	\$725

A primary point being illustrated above is that “either/or” options are not feasible in the beginning years. For example, with an *increase* in fuel management in year 1, we cannot conclude that a corresponding *decrease* in emergency suppression is logical. The more cause and effect relationships will not “kick in” until later – perhaps by years seven or eight after the beginning of the fuel management strategy.

Fire Planning

The Federal Wildland Fire Management Policy calls for “every area with burnable vegetation will have an approved Fire Management Plan”. Today less than 10 percent of these lands have approved and current Fire Management Plans. When asked would a Fire Management Plan have made a difference in the effectiveness of the suppression efforts for the Big Bar and Kirk Complexes, the answer was “YES.” When asked why there was no approved Fire Management Plans for the two involved Forests and other National Forests in general, the most common reason is lack of priority and resources.

Sound wildland fire management decisions and resource management decisions go hand in hand and are based on approved Fire Management Plans that are tiered to the Forest Land Management Plan. Within the Fire Management Plans we may want to include specific tactical emphasis for agency administrators and incident commanders on the development and use of “guerilla” firefighting tactics. These tactics are not new, but are not commonly used. “Guerilla” tactics involve limited firefighting resources, “best ridge” ideas noted in past reports, specific identification of agency administrator objectives, and National Forest System lands with low to high range resource/political values.

On a continuum of wildland resource-political values, we apply the appropriate suppression response on National Forest System lands ranging from wilderness to high value private land/structures. Most typically, we apply tactics consistent with either end of those values. We may only “monitor” or “confine” wilderness fire while “controlling”, at the minimum loss, fires near private land and structures. Tactics at each end of the continuum are fairly well developed. We use massive resources, with associated high cost, on one end of the spectrum. We use very limited resources with low costs on the other end of the spectrum. We need to improve the development of tactics to respond to those incidents in the middle of the continuum.

These tactics would involve applying operations on the ground where they would matter most to the agency administrator objectives. The tactics would need to be applied by highly skilled professionals. These tactics would typically involve higher uncertainty and greater risk than either side of the continuum. The compelling reason for dealing with higher risk and uncertainty is the reward of lower cost for the agency.

Fuel Management

Many earlier reports, including the Federal Wildland Fire Management Policy, the General Accounting Office Report GAO/RCED-99-65, and “Course to the Future: Positioning Fire and Aviation Management (May 1995, USDA Forest Service)”, emphasize the need for fuel management. As mentioned earlier in this report, the GAO concluded that “the most extensive and serious problem related to the health of forests in the interior West is the over accumulation of vegetation, which has caused an increasing number of large, intense, uncontrollable, and catastrophically destructive wildfires.”

A strategy is being developed to help solve this critical issue. The strategy, entitled, “Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy (Draft Report, December 3, 1999, USDA Forest Service)”, calls for a targeted

approach to removing excessive fuel through prescribed fire and mechanical treatments. The strategy is ambitious and will require significant increases in funding, even after base program funding shifts are made to reflect this priority.

Without an aggressive program in fuel management, especially in the interior West, effective cost-efficient fire suppression to protect lives, property, and natural resources will not take place.

Line Officer Responsibilities and Oversight

When the incident begins on the National Forest, the Forest Supervisor is in charge. When the Incident Management Team arrives to take over the management of the incident, the Forest Supervisor must stay engaged in the process. The Delegation of Authority letter is a contract between the Forest Supervisor and incident commander that ensures all fire suppression actions are managed in a safe and efficient manner. However, the overall responsibility and accountability for the incident rests with the line officer.

Proper oversight becomes a very important ingredient to the overall success of the management of the incident. In asking the question, “who provides the oversight to the line officer to ensure the best chance for success”, the answer is mixed, ranging from discussions with trusted staff to checking with past experienced colleagues. By most accounts, line officer involvement on the Big Bar and Kirk Complexes turned out to be good. Nevertheless, there does not seem to be a systematic approach to ensuring strong oversight of the line officer (as indicated by the line officers themselves for these two Complexes).

Consider the flip side in the case where the line officer wants to more readily delegate roles and responsibilities to the Incident Commander. While perhaps not the desired condition when this scenario takes place, who provides the oversight for the Incident Commander, especially if there is no Area Command in place?

Improved oversight and more aggressive engagement by the line officer with the incident being managed offers the chance to communicate that costs are a priority and keeping costs as low as practicable is expected. This can be and should be a predominate message.

National Large Incident Cost Oversight

The Forest Service Manual, regarding Large Incident Cost Review Procedures, calls for a national oversight team to be called when one or more of the following criteria are met:

- The incident has a control objective and the predicted time of control exceeds 5 days.
- A Type I or Type II incident management team is assigned to the incident.
- Actual or expected expenditures exceed \$5 million.
- There are significant political, social, natural resources, or policy concerns.
- The affected Regional Forester requests a review team.

The team shall be comprised of:

- The Associate Deputy Chief for State and Private Forestry, or a representative.
- An Assistant Director, Fire and Aviation Management, or a representative.
- An Assistant Director, Financial Reports and Analysis Staff, or a representative.
- The National Safety Officer, Human Resources Management Staff, or a representative.
- A representative of the Regional Forester.

- A Staff Director or representative from the affected natural resource functional area or administrative unit of concern.
- Representatives from affected agencies, if the incident is using multi-jurisdiction command.

Indications are, this direction needs to be applied more consistently, especially the direct engagement of the top leadership of the State and Private Forestry mission area.

The WFSA and the “Well Analyzed Fire Management Decision”

The Wildland Fire Situation Analysis (WFSA) is a tool that provides a systematic approach to strategic decision-making for fire suppression. Overall, it is accepted as a very good tool. Some consider it only a communications tool, while others find it useful for documenting decisions. Few use its full potential to display the tradeoff between costs and risk. The analytical components of the WFSA need to be expanded to better reflect issues associated with the wildland-urban interface and its use by line officers needs to be more consistent. Because of its potential, a more focused discussion of the WFSA is warranted.

The WFSA process as currently implemented is too much a “stand alone” tool, and set too far apart from the Land Management and the Fire Management planning processes, on which it depends. The WFSA and the Land Management Plan (LMP) need to be more closely integrated, not only in terms of information needs, but also conceptually in terms of how the LMP represents fire-related values, goals and objectives such that they are meaningful and useful as inputs to the WFSA.

The WFSA process cannot reasonably be accomplished within the time frame allowed between a determination that a fire has exceeded local suppression capabilities and the time an incoming incident team arrives. The WFSA process, to be completely successful, must benefit from some prework or templating that allows the WFSA team to draw from work done with the Land Management and the Fire Management planning processes. Priority needs to be given to accomplishing this prework, including relevant training in constructing and implementing WFSA templates.

Though the WFSA is generally regarded as a good and useful tool, there is a lack of confidence on the part of many users that they know what the WFSA is actually doing. Users need to understand in greater detail how the WFSA process operates to become comfortable with what is “going on inside the WFSA”.

Expertise in the WFSA is inconsistent across fire management organizations. Better and more consistent training in WFSA is needed, along with a set of benchmarks or standards for WFSA proficiency. Given the relative infrequency with which WFSA’s are done, a consistent program of retraining is needed.

Better integration of WFSA into fire management team activities, including Incident Management Teams, is needed. Current practices often result in the WFSA being done by one or two individuals with relatively little involvement by the line officer or other natural resource area specialists.

The current WFSA implementation is too limited as a risk analysis and risk assessment tool. The focus of the current WFSA is on problem structuring, values structuring, evaluation criteria, and economic assessment. Current WFSA implementation makes minimum use of uncertainty assessment techniques, and does not support methods for improving the quality of uncertainty assessments. To accomplish the goal of “well analyzed risks” would require an integration of the WFSA with other tools, particularly

the Rare Event Risk Analysis Program (RERAP), Fire Area Simulator (FARSITE), and other fire behavior analysis methods. This would require better integration of the WFSA with information resources, such as GIS. Such integration would impose new training requirements. Also, a risk analysis approach would require modeling of the effectiveness of fire suppression resources, both in terms of theoretical production rates (e.g., chains of line per hour per hand crew), and in the actual conditions under which the resources are deployed (e.g., environmental conditions, terrain, fatigue).

We need to understand that the WFSA does not guarantee well-analyzed decisions. Very often, the WFSA process is approached as something that must be done. To make better decisions requires a better job of analysis. The WFSA is a tool to *aid* that activity, but to do so effectively it must be used with full knowledge of its capabilities and limitations, and it has to be used constructively and creatively. Stepping through the WFSA software one screen at a time does not insure a “well analyzed decision”; indeed, it may actually lead to poorer decisions particularly when its use leads to fewer or lower quality inputs to the process. This can happen when critical resource area expertise is not consulted, when LMP information is not included, or when the various inputs called for in the WFSA software are not carefully thought through and critically evaluated. All fire suppression/management decisions should be made with good quality analysis even if the WFSA software is not available.

The “Militia” Approach

In the past when a fire occurred, non-fire personnel would make themselves available to serve. This is the Forest Service “militia” and it has worked exceedingly well. However, now there is an increasing shortage of the “militia” available for extended attack and large fire support in both direct suppression and fire support positions. There are many causes including overall reduction of personnel at field locations, lifestyle, economic, family, local work priorities, career tracks, etc.

One of the past recommendations was to “move toward preparing 75 percent of the workforce to be trained, qualified, and available to support fire emergencies by the year 2000”. This has not happened and probably will not for many of the reasons cited above. A recent briefing paper by one of the Forests involved in the Complexes that were examined concluded, “The Forest years ago lost its effective militia. While the Forest Supervisor supports participation (in fire suppression), individuals are not willing to abandon critical items in their program of work. Further, relief from targets is not granted and competing demands make it impractical for many employees to accept fire assignments.”

The same brief concluded, “this issue (an effective “militia”) cannot be reconciled in the field and, unless it is seriously and definitively addressed at the Secretary’s or Chief’s levels, we will remain in the unrealistic posture that professes to support employee involvement with fire while imposing roadblocks and providing relatively few incentives for those who serve.”

There are many reasons, other than demands of current work, why people in the agency may no longer view a fire suppression assignment as desirable, thus contributing to the notion that the “militia” approach needs to be reviewed. Some of the more prominent reasons include:

- Family commitments, especially childcare, with single parents or two-career families pose too great a conflict.
- The 21-day standard assignment is too long.
- Pay is not adequate.

- Supervisors are reluctant to let their people go, especially after multiple assignments.
- Fire management does not recruit, train, and qualify employees efficiently; employees grow weary of being in "trainee status" and not getting called for an assignment.
- Some people are never called, even though they are qualified. This is a double-edge sword. A critic might refer to this as "favoritism". That is, the same people always get called upon. Others might think of this in terms of a proven, tested commodity.

Harsher critics have reasons for lack of involvement that bite a bit deeper, including:

- Fire and Aviation Management does not want "non-fire people" involved in fire suppression.
- The fire suppression process lacks accountability and is characterized by reckless spending; accordingly, people that feel this way do not want to participate.
- Dispatch processes do not work or are inefficient.

The companion report to this effort, "An Agency Strategy For Fire Management", calls for a possible, partial solution through a national incident management organization for large fires and other disasters, in essence moving away from the "militia" approach to large fire suppression.

However, there is clearly not a consensus that discarding the traditional "militia" approach is the answer. A thorough analysis of this situation is important before we make any precipitous adjustments. Some believe there is much more we can do right now to get employees better involved. For example, the financial management specialists are busiest and generally unavailable the two months before the fiscal year closeout, which happen to be the worst fire months. Perhaps we can adjust the agency's financial management closeout requirements to be more flexible with fire suppression needs. Other items such as pay, workload, feelings of inclusion, etc., have already been mentioned.

Equal Pay for Equal Work

Over the years, many have written about the issue of the inequity of pay between Forest Service and other Federal firefighters and local/state resources. The issue centers on the Exempt/Non-Exempt rules for pay, a pay cap at the GS-10, Step 1 level, and time allowed for a given shift.

For example, on the Kirk Complex, State and local employees were paid based on a "Portal to Portal" concept. That is, they are paid from the time they leave their official station to the time they return. Their hourly rates are also more – about \$42/hour for State and local fire employees compared to about \$24/hour for a Federal employee. A typical shift length for a Federal employee was 14 hours; 24 hours for a nonfederal employee. In terms of costs to the fire, this translates into about \$1,006 per shift for the State and local employee and \$360 per shift for the Federal employee. Clearly, this creates an issue of morale. Working side by side, one would expect equal pay for equal work. This inequity must be corrected.

Because of the pay issues associated specific with California, it is estimated that about \$25 million could have been saved on the two Complexes if Federal employees could have staffed the entire incident.

A compromise is probably the better solution. That is, continue to use State and local resources for fire suppression on public lands, but at a more limited rate, and increase the incentives for Federal employees who are on the front line or in some way involved with the incident. This will also have significant positive impacts on issues associated with fire preparedness.

This pay issue impacts the availability of personnel to fill key fire management positions. In many cases, largely due to the pay cap, highly qualified personnel will not work on fires because their overtime pay is less than they normally earn in straight pay status in their normal job. Fighting fires is hard, hazardous work. We should provide some incentive for the Federal employees who take on these fire suppression assignments.

There may be some relief in sight. Current legislation is being considered by Congress that will provide relief from the GS-10, Step 1 pay cap.

Pay issues, including the Fair Labor Standards Act (FLSA) and Hazard Pay, also affect the Burned Area Emergency Rehabilitation (BAER) program. Some BAER specialists are more willing to work on a fire in a labor position than in a management or technical position for which they are qualified, because they wish to be “non-exempt” from the FLSA for pay purposes. Further, it is demoralizing for BAER personnel to be working on damage survey within the burned area, side-by-side with mop-up firefighters, without getting Hazard Pay. These two issues have resulted in BAER Teams being hard to form and a need to fill specialist positions with contract employees at a higher wage scale.

This issue needs to be applied to state and local employees who also experience lower pay rates. Fundamentally, all personnel that participate in fighting fires should expect to receive equal pay for equal work, regardless of the organization.

Siege Fires

Fires become costly, in part, because of factors that influence the time span over which an incident continues. It appears that some incidents become “siege fires”, in which a combination of national priorities, environmental conditions, and social factors (including human resource factors) lead to circumstances that can be characterized as a “siege mentality”. These circumstances appear to impact personnel in terms of their perception of control of the incident, and may reduce their ability to sustain both the physical and psychological workload associated with such fires.

Team Recommendations

The following are recommendations to improve the overall effectiveness and cost-efficiency of large fire management. Many of the recommendations, even though specific to the two Complexes examined, have national implications. Accordingly, the team recommendations will not be separated (like in the findings) in this section of the report.

Increase initial and extended attack resources. This includes:

- Budgeting for preparedness resources at the Most Efficient Level *to the field*.
- Developing a cohesive, long-term budget strategy that includes preparedness, emergency suppression, fuel management, and state fire assistance in order to implement an effective, cost-efficient fire management program.
- Reducing the administrative support cost of the fire management program.

Implement fire management planning on a large scale, with a consistent basis.

This includes:

- Incorporating wildland fire concepts into the Natural Resource Agenda and ensure it is recognized as critical to the health and sustainability of our forests and range ecosystems.
- Tiering fire management planning to the Forest Land Management Plans.
- Placing fire as an equal resource in the land management planning process. Community involvement and education is important.
- Highlighting the use of specialized or “guerilla” firefighting tactics that call for limited firefighting resources, “best ridge” concepts, specific identification of agency administrator objectives, and lands with low to high range resource/political values.

Implement an aggressive fuel management program. This includes:

- Implementing “Protecting People and Sustaining Resources in Fire-Adapted Ecosystems”.
- Providing for the Fire and Aviation Management staff, at the national level, to lead and coordinate the above strategy as an “incident concept” through a “Fuel Reduction” group.

Line officers remain engaged in fire suppression actions to ensure the fire is managed in a safe and efficient manner. This includes:

- Constructing a more systematic and consistent approach to oversight of line officers.
- Providing a predominant message that costs are a priority and are expected to be as low as practicable in the management of the incident.
- Ensuring Tribal relationships are well managed on incidents through an experienced local liaison. This includes having all appropriate agreements with Tribes in place.
- Adjusting terms for fire contractors (goods and services) to allow for cost adjustments on long-duration fires (economies of scale).

The top leadership of the State and Private Forestry mission area, specifically the Deputy Chief and the Associate Deputy Chief, need to be more consistently involved in large fire incident cost reviews.

Update fire management technology to keep pace with today’s fire suppression complexities. This includes:

- Adjusting the NFMAS model to include the values associated with the wildland-urban interface adjacent to the National Forest Boundary and generally improves the quality of information included in the system.
- Expanding the capability of the WFSA to better reflect issues associated with the wildland-urban interface. The WFSA use needs to be more consistent and aggressive, including its use in pre-fire planning.
- Developing training and certification programs for the WFSA.
- Developing fire behavior software that can be used for regional priority assessment.
- Standardize, improve, and institutionalize models like the Fire Area Simulator (FARSITE) and Rare Event Risk Analysis Program (RERAP) to improve fire suppression capabilities.

Reassess the “militia” approach to large fire suppression. This includes:

- Implementing “An Agency Strategy for Fire Management”.
- Reviewing “red-carded” employees. Those who do not participate should be removed from the system.
- Implementing a mentoring program to improve fire management skills for all engaged in fire suppression.

- Eliminating the GS-10/1 pay cap to create better pay incentives for Federal employees who participate in wildland fire suppression.
- Using only crews with proven qualifications who are sanctioned or certified as wildland fire fighting crews.
- Being more aggressive in calling for available crews, nationwide. Some crews, especially those in the east, are well qualified but are not being called to participate on western fires.

Begin a study of selected large fires to develop a better understanding of how incidents are at risk of becoming “siege fires”, and what steps can be taken to reduce the risk.

Conclusions

The examination by this team *did not* identify anything that could have *significantly* reduced the costs of managing the Big Bar and Kirk Complexes. However, other factors might have improved the overall efficiency of fire suppression efforts, and thus reduce some costs. Several recommendations have been made. This is not new and most of our recommendations are not new. Over the past several years many well written reports have made over 100 recommendation that, if implemented, would have improved the fire management program and perhaps kept the agency from the current crossroads that suggest more extreme action is required.

This report concludes the following:

- Fire management should and must be one of the agency’s top priorities.
- Adequate funding to ensure effective initial and extended attack cannot be overstressed.
- Fire planning and fuel reduction need to be approached much more aggressively to improve our ability to manage large fires safely and at a reasonable cost.
- The analytical tools of fire management are no longer adequate to keep pace with today’s complexities of fire suppression.
- The traditional “militia” approach to fire fighting is no longer valid.

The answer seems so simple: act now, establish wildland fire management as a top priority and begin to implement the recommendations that will ensure we meet our role and responsibility in protecting lives and property from wildland fires.

Appendix A

Q&A's From The Region 5 Interview

Note: The following are the Questions and Answers from the interview by the team with the Forest Supervisors and their staffs on November 30th regarding the Kirk Complex on the Los Padres National Forest and the Big Bar Complex on the Shasta-Trinity National Forest. This Six Rivers National Forest was included in the interview.

1. *Is the current fire management policy and direction adequate to ensure effective and cost-efficient fire suppression?*

Generally, the fire policy and direction is adequate. Costs could be reduced if there was a better recognition of the duration of fires in dealing with contracts for services. In other words, economies of scale should be instituted. Clearly, cost considerations are a national issue. There needs to be a much more focused national effort to ensure that reasonable fire suppression costs are always a top consideration.

2. *Are fire preparedness levels adequate to offer a wide range of suppression alternatives?*

There were adequate resources, initially. However, as conditions changed, levels of resources and types of resources became inadequate to meet the planned fire suppression strategies. It is not realistic to plan for the worst-case scenario. Most of the time, our preparedness levels and the funding proposed through the National Fire Management Analysis System (NFMAS) have been adequate. However, over the years the resource levels for initial attack and extended attack have eroded due to funding reductions and now our ability to offer an adequate range of fire suppression alternatives is beginning to be in doubt. However, a lack of resources for initial and extended attack was not an obvious issue, at least in the Big Bar Complex.

An important question to ask is, “what is the public willing to accept in the short term concerning damages to property and lives.” Currently, that threshold (*set by the public*) on accepting damages is extremely low and the expectation on all fires is that we aggressively try to control them. We may not have the capability to do this effectively or cost-efficiently, at least in the near future if the current trend continues.

3. *Was cost a priority on the Big Bar and Kirk Complexes? If so, how did costs rank with other issues such a safety, ecosystem management, other social values, etc.?*

Costs were always a high priority, but never more than the safety of the firefighters. We believe we consistently looked for ways to reduce costs, but social and political concerns were often competing objectives. There was adequate oversight regarding costs on a continual basis. We are not sure we could do much more about reducing the costs associated with these two complexes. Once it became clear that the fire might reached the Hoopa Indian Reservation (on the Big Bar Complex), the fire suppression strategy changed to a more expensive enterprise. This probably could have been improved with a more effective liaison with the Bureau of Indian Affairs.

Weather, access, and terrain are factors that have dramatic impacts on the cost of fighting fire. All of these were critical issues on both complexes. Fighting these fires was an expensive proposition from the beginning.

A catastrophe to one is an opportunity to another. The funding associated with large fires can contribute significantly to local economic conditions. A well-analyzed strategy through a WFSA may call for an indirect and “let-burn” suppression tactic. External

forces may view a more direct tactic is better even if a more aggressive approach will ultimately make little or no difference in outcome of the fire. External forces exert influence and additional resources may be employed for other than a tactical fire management reason. Costs will soar. This scenario must be resisted.

4. *When it comes to costs, what threshold levels or “red flags” do you have available to signal a major decision point?*

After \$5 million, it is really not clear what level begins to trigger a concern or re-evaluation of a strategy. We are all aware that costs are increasing, but after a certain point in time people just knew these were going to be very costly fires to fight. There were no black or white thresholds. But, we did keep the regional and national offices informed so there would be no surprises.

5. *Which items contributed most significantly to the costs of the Big Bar and Kirk Complexes?*

Primarily the way the fires had to be fought (the tactics) to ensure safety, dealing with the rugged terrain, meeting wilderness values, endangered species management, and the extensive use of interagency teams, which are very expensive to operate. Smoke inversions caused some equipment to be grounded. Inadequate overhead to control equipment caused some heavy equipment to go unused. Examples included dozer bosses, falling bosses, etc.”

Also, there is a changed expectation in the use of electronic technology and “creature comforts”. These may help improve fire control strategies and ultimately affect the safety of the firefighters. However, they also add to the overall cost of fire suppression.

Finally, there is the makeup and specific culture of the Incident and Area Management Teams. Candidly, some are more aggressive than others and this impacts the resource levels applied to manage the incident. This is not to second-guess which is right or wrong. It is simply a fact and costs are influenced accordingly.

6. *If you could change anything regarding the fire control strategy for these two fire Complexes, would you? If yes, what were the three primary things you would change?*

We have thought about this a lot and on the Kirk Complex we would not change the way we managed this incident initially. On the Big Bar Complex, better pre-planning of camp locations and detailed agreements in place with the tribal governments would have improved our overall efficiency. We would not have changed the fire tactics, however.

There needs to be better flexibility in team composition and rotation. Having these flexible standards in place significantly improves the overall effectiveness of the management of the fire.

Certainly there are operational actions that can always be improved upon. However, in the larger context of managing these two complexes, with the ebb and flow of the conditions that were present, the three Forests believe their overall approach was appropriate.

7. *If there is an opportunity to change the Forest Land Management Plans, what would you change based on what you have learned from these two fire Complexes?*

The need for fire planning tied to the Forest Land Management Plan is critical and needs to be emphasized. This will improve our abilities to manage ecosystems, smoke from fires, improve strategies for large fire management, and define effective rehabilitation tactics. The Forest Land Management Plan should bring fire on line as an equal resource.

8. *Is there any other information you would like to provide to this team?*

The Los Padres National Forest is 50 percent wilderness and 80 percent unroaded. When the forest went from two helicopters to one, their ability to manage multiple fires was compromised. Some Type II teams need reminders for managing the expected transitions to Type I teams. There needs to be a national effort on fire line rehabilitation. The Burn Area Emergency Rehabilitation (BAER) national direction is not clear. There are differences in interpretation of BAER team responsibilities and expenditure authorities among federal agencies in the Departments of Interior and Agriculture. Structure protection and the Federal role of wildland fire suppression remains an issue. We want to do what is right, however, the cost of this role is very expensive. Information management could be improved to emphasize the importance of community liaison roles, not just fire information updates. We need to involve people in the communities affected. We need to make decisions more transparent and available to enable the public to understand resource tradeoffs and costs, when communities are truly in harms ways, and what fire management can do to ultimately prevent the loss of property and lives through tactics such as fuels management. Keeping people better informed with clear, timely, and accurate information while the incident is underway is critical.

Many communities in the vicinity of wildfire suppression show some level of economic dependence. Those communities recognize that the federal government needs resources to fight the fires and they want to provide as many of those resources (people, supplies, etc.) as they can if for no other reason than the economic expansion this represents.

Some communities are more aggressive than others in seeking to participate. Often the government is viewed as an open checkbook. At least that is the perspective of some. On the other hand, from the Forest Service perspective, using local resources may well be more cost-effective than bringing resources from remote locations. Also, the use of local resources often results in additional, although often intangible, benefits to the government, including, better relationships, enhanced flow of information, local knowledge, etc.

We do not think any of our decisions to use local resources prolonged the fires. The majority of these choices were cost-neutral or beneficial to the government. However, some decisions did increase costs. These included:

- The community of Denny is very remote, with many of its citizens, accustomed to the life-style that remoteness affords them, and are suspicious of outsiders, especially the government. Relationships with some community members and communication/information flow with the community were two issues we dealt with the entire time Denny was threatened by fire. For several weeks we had a camp in Denny, which the community did not want. They considered it intrusive, at best. We kept the camp there as long as we thought it was tactically advantageous. However, we employed local fire engines to patrol the community longer than was tactically necessary. This provided a good pipeline of information to the community and seemed to enhance our relationship with them.

- The Hoopa Valley Indian Reservation Chairman stated numerous times that his primary objective in addressing the fire was employment. The Memorandum of Understanding (MOU), signed with the Hoopa Valley Indian Reservation months before, did not address roles and responsibilities for firefighting. The MOU the Klamath National Forest signed with the Karuk Indian Reservation, as an example, did clarify the roles. One of the ICs negotiated the hiring of cultural monitors (number as well as pay rate) with the Hoopa Valley Indian Reservation. The rate in this case was above the maximum described in the Karuk-Klamath National Forest MOU. When this became known, the Karuk Indian Reservation wanted parity.

An additional complication involved the perceived complexity of duties. Apparently, the duties being performed by the Hoopa Valley Indian Reservation monitors were recognized as lower-graded duties in the Karuk-Klamath National Forest MOU. So effectively, the Karuk monitors were performing higher-graded duties and being paid less.

Discussions with the Hoopa Valley Indian Reservation about reducing the number or pay rate of their monitors resulted in threats and suggestions that the Forest Service was racist. To try to preserve the relationship, we honored the initial negotiations, even though it resulted in increased costs and perhaps questionable benefits.

9. *What fundamental points should this report on the “Policy Implications of Large Fire Management” include?*

The report needs to highlight actions and activities that increase costs, such as interagency teams, the use of high-end technology, maintaining a wide range of “creature comforts”, and ensuring firefighter safety. We should strive to not compare fire suppression costs of the 60’s with today’s costs. Today fire management is much more complex. Fundamentally, to meet environmental, social, political, and safety issues that we are faced with, a large fire is going to cost \$1 million dollars or more each day to manage. Also, fighting fires in remote locations requires a different strategy. Remember, terrain and access (or lack of) can dramatically increase the cost of fire suppression, depending on the specific strategy. The Kirk and Big Bar Complexes reflected many of these actions, activities, and conditions. Native American issues were an additional complexity and challenge on the Big Bar Complex. We must be better prepared to deal with these issues in the future.

In the future, we will have to depend more on contract crews, we will need better controls for contract preparedness, training, equipment, and safety.

10. *Were Forest personnel assigned to the fires adequately skilled?*

Generally, we had the skills that were needed but adequate resources were slow in arriving. Some of the expertise was lacking. On the Big Bar Complex, the crews from Region 6 were from contract sources and some were good and some not so good. People who arrived with skills based on self-study courses were not well prepared. A skilled liaison dealing with Native American issues would have been extremely helpful.

11. *Was the Wildland Fire Situation Analysis (WFSA) helpful?*

On the Kirk Complex, the WFSA was an effective tool. On the Big Bar complex, there were reservations in its use. Some felt they did not clearly understand what the system was providing them. Trying to get the IC Teams involved with the WFSA on the Big Bar was at times an issue. It appears like the Shasta-Trinity National Forest actually did the WFSA on the Big Bar Complex with the IC Teams coming along.

12. *Did the Forest Supervisors establish spending conditions and guidelines for the IC Teams during the takeover briefings at the beginning of each new team assignment?*

The Forest Supervisor for the Los Padres National Forest established conditions and guidelines through the WFSA, which guided costs. Cost efficiency was always emphasized at transition meetings and briefings.

The Shasta-Trinity Forest Supervisor established the management of costs as an objective in all letters delegating authority to the various Incident commanders. A full-time Forest Incident Business Advisor (IBA) was assigned to all teams at Big Bar. A Forest-wide IBA was established to coordinate the team IBA's. The Forest IBA, at all briefings, provided verbal direction. Language in the Delegation of Authority included, "You are expected to do a complete and efficient job, while providing for SAFETY. Cost-effective incident management should be a significant consideration for the decisions made by you and your team."

13. *What type of guidelines on spending did the Area Command and IC's establish?*

Costs were guided by the most effective methods to ensure firefighter safety while being employed in rugged, remote terrain and using suppression methods that were light on the land to help meet wilderness objectives.

Written guidelines were provided to the Area Command from the Forest IBA. The Area Command attached these to the delegation memos to the Incident Commanders.

14. *Recently a member of Congress asked why we did not use more of a "let burn" approach to be the strategy for the Kirk Complex. Would the Los Padres National Forest please answer this specific question?*

The Los Padres National Forest does not have the option, under the current Land Management Plan, to use a "let burn" strategy. All fires must be suppressed with appropriate tactics. However, the Forest does acknowledge that a Fire Management Plan for the Ventana Wilderness is needed and intends to develop this plan from the Kirk Complex and the records from the 22-year-old Marble Cone Fire, which occurred under similar conditions. The Forest is depending on Regional Office support to help accomplish this.

Appendix B

Literature Used in the Development of the “Policy Implications of Large Fire Management: A Strategic Assessment of Factors Influencing Costs”

1. *Young Men and Fire*, 1984, Norman Maclean
2. *Fire Related Considerations and Strategies in Support of Ecosystem Management*, January, 1993, USDA Forest Service
3. *South Canyon Fire Investigation* (of the 14 fatalities that occurred July 6, 1994 near Glenwood Springs, Colorado), Multi-Agency Report, August 17, 1994
4. *Course to the Future: Positioning Fire and Aviation Management*, May 1995, USDA Forest Service
5. *Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season*, August 1, 1995, USDA Forest Service
6. *Fire Economic Assessment Report*, September 1, 1995, USDA Forest Service
7. *Federal Wildland Fire Management Policy and Program Review, Final Report*, U.S. Departments of Interior and Agriculture, December 18, 1995.
8. *California Fire Plan: A Framework for Minimizing Costs and Losses from Wildland Fires*, March 1996, California Department of Forestry and Fire Protection
9. *Land Management Considerations in Fire-Adapted Ecosystems: Conceptual Guidelines*, August 1996, USDA Forest Service
10. *Fire Suppression Costs on Large Fires, Oversight Report*, September 10, 1996, USDA Forest Service
11. *Western National Forests: A Cohesive Strategy to Address Catastrophic Wildfire Threats*, Report to the Subcommittee on Forests and Forest Health, Committee on Resources, House of Representatives, April 1999, The US General Accounting Office
12. *Large Fire Strategy, Committee Report*, May 1996, USDA Forest Service
13. *Fire on the Mountain: The True Story of the South Canyon Fire*, 1999, John N. Maclean
14. *Restoring Managerial Accountability to the United States Forest Service*, August, 1999, National Academy of Public Administration
15. *The National Large Incident Cost Oversight Report*, High Complex, Shasta-Trinity National Forest, September 2, 1999, USDA Forest Service
16. *NASF Report on Efficient Utilization of Forest Fire Suppression Resources*, September 17, 1999, National Association of State Foresters
17. *The National Large Incident Cost Oversight Report, Kirk and Big Bar Complexes*, Pacific Southwest Region, September 30, 1999, USDA Forest Service
18. *An Agency Strategy For Fire Management, Draft Report*, November 15, 1999, USDA Forest Service
19. *Review of the Megram Fire, Shasta-Trinity and Six Rivers National Forests, Internal Working Paper*, November 30, 1999, USDA Forest Service (Mr. John Wendt)
20. *Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy*, Draft Report, December 3, 1999, USDA Forest Service
21. *National Advanced Resource Technology Center, Lesson Plan, “When is Enough Enough?”*, Rick Gale, Area Command S-620

Appendix C

Literature Review Analysis, Large Fire Strategy, Committee Report, May 1996, USDA Forest Service

Note: The following matrices, Appendices C through I, lists some of the key recommendations in the listed subject matter literature and how the Big Bar and Kirk Complexes seem to address or responded to these recommendations. A rating of 10 is the highest; 0 is the lowest.

Report	Issues	Key Recommendations	Complexes
Large Fire Strategy:	Land Management Planning	1. Improve LMP to include a comprehensive Fire Management (FM) strategic direction.	2
		2. The FM strategy should be compatible with other resources objectives.	6
		3. Review of WFSA's (Wildland Fire Situation Analysis) should be part of the LMP monitoring process.	6
	EFSA	1. Require minimum suppression effort alternative for each EFSA.	7
		2. Require a cost/lost evaluation of tactical constraints be considered in the EFSA development.	6
	Training	1. Develop presentation package that promotes large fire strategies for line officers; IC's and ICT (T1 and T2.); FMO and DFMO.	6
		2. Combine FBA and PFBA training.	7
	FSA	1. Adopt the use of a FSA process to evaluate fire strategy and tactics for fires that do not require an immediate control action.	7
		2. Use the FSA in a process similar to that used for prescribed natural fire.	7
		3. Require line officer approval on fires where Confine or Contain strategies are applied because of the FSA.	9
	Structure Protection	1. Develop alternatives using the EFSA process (or similar) where the USDA Forest Service is expected to bear the cost of structure protection.	7
	Airtankers and Heavy-Lift Helicopters	1. Assign airtankers and heavy-lift helicopters to large fires based on mission specific requests rather than general support.	6
	Strategy and Tactics	1. Prioritize fires.	8
		2. Ensure firefighter safety.	10
		3. Selection of innovative and alternative strategies and tactics needs to be emphasized. Use elements of Confine and Control.	8
		4. Use "calculated risk".	5
		5. Always consider falling back to the "best ridge" rather than the "next ridge".	6
		6. Carefully examine hand crew intensive strategies.	7

Appendix D

Literature Review Analysis, Large Fire Strategy, Fire Suppression Costs on Large Fires: A Review of the 1994 Fire Season, August 1, 1995, USDA Forest Service

Report	Issues	Key Recommendations	Complexes
Fire Suppression Costs on Large Fires:	Explosive Fuel Types (EFT)	1. Adapt to changes in fuel conditions that reduce the effectiveness of traditional suppression tactics and abandon tactics that are no longer effective.	6
		2. Develop a communications plan that promotes an understanding that fire is a normal part of many forest ecosystems.	6
	Large, Costly, Long-Duration Fires	1. Assess strategy and priority of large fires anytime a key factor changes, including repeated suppression failures.	6
		2. Use the latest technology and modeling techniques for resource allocations and prioritizing incidents.	7
		3. Ensure preparedness through NFMAS is at the most efficient level.	7
	Calculated Risk-Taking (CR-T)	1. Encourage well-analyzed risks in order to reduce costs.	6
		2. Conduct reviews of overly expensive fires.	7
		3. Provide incentives for cost reductions.	2
		4. Emphasize the importance of the EFSA and include alternative minimal suppression actions for fire not contained within 5 burning periods.	6
	Protect Private Property	1. Review the role in suppressing wildfires that threaten private property.	7
		2. Change the policy on priorities for fire suppression from life, property, and resources to life and values at risk.	4
	Resource Impacts vs. Minimize Acres Burned	1. Require tradeoff analysis for suppression alternatives and tactics.	8
	Use of Type I Helicopters	1. Ensure the ICT completes a benefit/cost analysis when using this resource and provide adequate management.	7
	Skilled Personnel Available	1. Increase the participation of agency personnel in fire suppression activities by 75 % of the workforce re-carded.	5
		2. Develop alternative methods for assistance.	6
		3. Define the role of the AO and comptroller in the development and selection of the suppression alternative.	6
		4. Review the possibility of legislation to exempt emergency response work from the FLSA.	5

Appendix E

Literature Review Analysis, NASF Report on Efficient Utilization of Forest Fire Suppression Resources, September 17, 1999, National Association of State Foresters

Report	Issues	Key Recommendations	Complexes
NASF Report	Skilled Personnel	1. Ensure proper training, including the use of the WFSA.	7
		2. Incident objectives must be linked to the costs of attaining them.	6
		3. Conduct business reviews during the incident.	8
		4. Expand financial assistance to states and volunteer fire departments.	3
	Calculated Risk-Taking	1. Support line officers that make sensible, yet difficult, or politically unpopular choices in order to reduce costs.	9
	Efficient Dispatching	1. Require local dispatchers to fill orders locally.	5
		2. Encourage flexible staffing for smaller fires.	4
	Preparedness	1. Ensure preparedness levels are adequate for effective initial attack.	7
		2. Emphasize flexible staffing for extended attack and for smaller fires.	4
		3. Prioritize fires.	7
	Fires in the Wildland-Urban Interface	1. Implement the "FireWise Community" effort.	4
		2. Assess all interface areas and rate them according to their defensibility.	7
		3. Establish written agreements for the protection of structures in the interface.	5
	Cost Effective Tactics	1. Require annual reviews of example large fires.	7
		2. Encourage prudent night operations.	5
		3. Encourage the use of medium and light air tankers.	4
	Improved Dialogue	1. IC's, fire managers, and agency administrators should formally meet to discuss key issues.	8

Appendices F, G and H

Literature Review Analysis, Western National Forests: A Cohesive Strategy to Address Catastrophic Wildfire Threats, Report to the Subcommittee on Forests and Forest Health, Committee on Resources, House of Representatives, April 1999, The US General Accounting Office; Land Management Considerations in Fire-Adapted Ecosystems: Conceptual Guidelines, August 1996, USDA Forest Service; Course to the Future: Positioning Fire and Aviation Management, May 1995, USDA Forest Service

Report	Issues	Key Recommendations	Complexes
GAO Report	Cohesive Strategy	1. Develop a cohesive strategy for reducing and maintaining accumulated fuels at acceptable levels for the interior West forests.	3
Land Management Considerations	Summary	1. Fire is a natural part of the ecosystem.	7
		2. Fire exclusion has environmental and economic consequences.	7
		3. Risk avoidance is costly.	8
Course to the Future	Physical Environment	1. Prioritize funding for prescribed fire treatments.	6
		2. Display economic tradeoffs of long-term fire suppression in Forest Plans.	5
		3. Develop a skilled workforce capable of protecting the forests.	7
		4. When conducting the EFSA, evaluate alternative suppression strategies.	7
	Social and Political	1. Improve understanding of fire's role in the ecosystem.	7
		2. Expand partnerships and coordination.	8
	Economics	1. Strengthen and improve the standards and requirements for the EFSA.	5
		2. Establish a delegation of authority for EFSA signature based on fire complexity and cost projections.	8
		3. Develop alternative strategies for effective fire management.	8
		4. Reexamine risk assessments.	6
	Organizational Environment	1. Reinforce the notion that all FS employees are responsible to provide some level of support during fire emergencies.	5
		2. Develop a long-term workforce plan to ensure adequate skills in fire and aviation management.	4
		3. Strengthen the skills of line officers in fire management.	6
		4. Promote efforts to revise pay regulations, which discourage employees from serving in incident management positions for which they are highly qualified.	7

Appendix I

Literature Review Analysis, Fire Economic Assessment Report, September 1, 1995, USDA Forest Service

Report	Issues	Key Recommendations	Complexes
Fire Economics Assessment Report	Prescribed Fire	1. Establish a landscape scale prescribed burning program at 3 million acres by the year 2005.	2
		2. Target fuels treatment to high-risk areas.	4
		3. Target fuels treatment to ecosystems that are not sustainable because of the exclusion of fire.	4
	Agreements	1. Clearly specify agreements within the wildland-urban interface to recognize the limited role of the Forest Service to protect structures.	6
	Alternative Strategies and LMP's	1. Display economic tradeoffs of long-term fire protection strategies in Forest Land Management Plans.	7
	EFSA	1. Recognize and evaluate the long-term effects of fire on ecosystems and the cost of suppression strategies in the Escaped Fire Situation Analysis.	7
		2. Improve EFSA (now WFSA) standards and requirements, streamline process, and train fire managers to use it in real-time situations.	5
		3. Establish WFSA delegations of authority. High cost decisions should be made by those with high levels of skills and knowledge of fire issues.	8
	Oversight	1. Increase oversight and accountability on large fires.	6
		2. Establish job performance requirements for fire managers. Better-trained and qualified fire managers make better decisions.	7
		3. Conduct reviews during fires and provide coaching for line officers. Allow for midcourse corrections.	7
	Preparedness Through NFMAS	1. Increase preparedness funding.	6
		2. Include fuels and blackened acres from wildfires as interactive parts of the analysis.	5
		3. Conduct a sensitivity analysis to determine the driving variables in calculating MEL.	5
	Access	1. Increase road and trail maintenance. Access is the No. 2 ranked issue regarding increased cost of fire suppression.	6
	Resources	1. The amount and type of resources is critical (ranked No. 9 in importance of 32 variables). Thus, resources need to be available and the correct skill mix maintained.	5

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