The Future of Wildland Fire Management

Advance Briefing Report
For the Quadrennial Fire Review Working Panels

QFR 2009

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This Advance Briefing Report was managed under a contract with the Brookings Institution's Center for Executive Education. The Statements herein represent a synthesis of alternative viewpoints and perspectives from fire researchers, academics, and external experts who were consulted during this research phase.

The Quadrennial Fire Review (QFR) process is intended to provide a range of ideas about possible futures and prospects for change in the environment. The ideas presented are intended to be provocative and speculative. As such, they are not intended, nor should be construed to represent official policy statements or positions of any federal government agency.

Comments, of course, are welcome.

Further suggestions, ideas, or other perspectives can be forward to:

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Dr. Albert C Hyde was the Project Director for this report. He is a Senior Consultant to the Brookings Center for Executive Education, which provided administrative support for this project. R Gordon Schmidt was the Senior Project Advisor, and also is a Staff Consultant to BCEE. As with all Brookings works, the analysis and views expressed in this document are solely those of its authors and members, and do not reflect the views of the Brookings Institution, its Trustees or its research staff."

The Future of Wildland Fire Management: Fire Research Perspectives

Advance Briefing Report

For the Quadrennial Fire Review Working Panels

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Introduction

The 2009 QFR Process (Quadrennial Fire Review) was formally initiated with a robust research phase throughout 2007. Fire researchers, environmental and social scientists along with technology experts were asked to assess the key driving forces for the next 25 years that would most impact wildland fire behaviors, risks, and consequences and what specific trends would likely impact fire management strategies over the next 5 years. It was the specific intention of this phase to juxtapose ecological futuring and social dynamic forecasting perspectives on fire to challenge current assumptions of wildland fire management.

The phase began with several core themes – which included:

Fire and Global Warming/Climate Change
Fire and Vegetation Management
Growth and Change in the Interface
Organizational Dynamics (Future Workforce, Risk Trends, Performance)
Measurement and Technology Development Briefs
Big Science – Future Landscapes, New Eco-Boundaries, Carbon and Biofuels, Restoration Issues

Select Researchers from different sectors (and countries) were invited to prepare what was terms a "New Assumptions" presentation and then participate in a November Fire Research Forum that was co-located at the Brookings Institution in Washington and NAFRI in Tucson and linked via teleconferencing.

This report gratefully acknowledges the contributions of the following researchers who prepared new assumptions presentations for the November Forum:

Tim Brown, the Desert Research Institute, University of Nevada-Reno
Susan G. Conard National Program Leader, Fire Ecology Research
M. D. Flannigan, Canadian Forest Service
Sue Stewart, USDA Forest Service, Northern Research Station
Sara McCaffrey, USDA Forest Service, Northern Research Station
Karlyn Bowman, Senior Fellow, American Enterprise Institute, Washington DC
Ron Neilson, USDA Forest Service-Pacific Northwest Research Station
Mike Pellant, Bureau of Land Management
Brian J Stocks, Canadian Forest Service
Mark Finney, US Forest Service, Fire Science Laboratory, Missoula MT
Steve Palmquist, CMU- Software Engineering Institute
Eileen Forrester, CMU – Software Engineering Institute
Matt Rollins Fire Effects Project – Fire Science Lab, Missoula

The Forum benefitted greatly from the participation of Tom Harbour, the Director of US Forest Service Fire and Aviation Management who provided the keynote address for the event (a transcript is included in this document). In addition, Mike Hilbruner, National Program Leader for Fire Systems Research for the Forest Service, Forest Management Science, provided contextual introduction for the forum and research goals, as part of his role as co-lead for the year long QFR research phase.

The QFR Phase I research presentations were reviewed and assessed by a specially convened Research Advisory Panel. This group of agency research managers and scientists met first to review the topics and preliminary paper drafts submitted for the November Fire Research Forum and propose cross-cutting issues and questions for further discussion. Following the forum the Panel assessed the forum presentations in depth and rated which of the various driving forces and emerging trends the QFR working panels should consider as most significant on preparing future alternatives.

What follows in this "Advance" document is a synthesis of their highest rankings and probable assessments of significance. This approach to presentation neither states the degree of certainty of the driving forces identified nor of potential risk. As with the 2005 QFR report they merely point to future directions and pace of change (i.e. which factors purporting what levels of change) should new management strategies for the future of wildland fire management be considered.

This report gratefully acknowledges the following members of the Panel for their contributions to QFR process and their ongoing support as "advisors":

Mike Hilbruner - US Forest Service
Rich Lasko - US Forest Service
Elisabeth Brouwers - US Geological Survey
Carol Miller - US Forest Service
Colin Hardy - US Forest Service
Eric Berg - US Geological Survey
Jeffrey P. Prestemon - US Forest Service
David V. Sandberg - Sam's FireWorks
Sarah M. McCaffrey - US Forest Service
Dr. William (Ruddy) E. Mell - National Institute of Standards and Technology
Dr. John R Shelly - University of California at Berkeley
Tim Swedberg - National Interagency Fire Center

2009 Quadrennial Fire Review Keynote

Presented By: Tom Harbour, Director, Fire and Aviation Management, US Forest Service

Four years ago, the inaugural Quadrennial Fire Review Report (QFR) was prepared and accepted across the five federal agencies as a comprehensive portrait of the future of fire. The report not only reviewed the successes and challenges of the past, it took a long-term view toward the future—a view which proved to be exceptionally accurate.

Today, November 2, 2007, the Forest Service and our partners kick off the next generation of the Quadrennial Fire Review (QFR). This next QFR must be as successful as the first.

As we kick this off, I'm thinking 5 to 20 years ahead. In wildland fire and aviation management, we kid ourselves about living in the moment, but we also do great work in contingency planning and that's what we will be doing, in part, with this QFR. We are thinking about "what might be," while considering what we already know is inevitable.

For example, we know the importance of improving forest health to reduce the impacts of fire, control invasive species, manage outdoor recreation and address the loss of forests and other open spaces to development—better known in the Forest Service as the "Four Threats." The Forest Service's work in these areas continues to be vital but along with those four, comes other emerging concerns—some already identified such as climate change, reduction of carbon emissions, the dwindling supplies of pure, clean water, and the importance of ensuring the future generations can understand how much they depend on the forests, no matter where they live and be able to carry our work forward to make certain the nature resources are preserved and there for future generations, as well other issues not yet identified.

In commencing our second QFR, I intend to be provocative about the future; I want us to be provocative! I enjoy the dialectic and hope to start the QFR journey with some thoughts which will stimulate thinking. I want us to do this thinking together in order to influence the journey and the destination.

It is not my intent to spend time on organization centric issues—especially those of the US Forest Service, which has been my employer for each of my 38 fire seasons. Ultimately, I want to review things from the macro level; but prior to that assessment, there are some basic micro-level, human issues I feel need reviewed.

Basically, the interface between the person considering the flame and the flame has not changed much for a very long time. At the edge, that interface will continue to develop over the next decades. The most difficult flames will become more complex, and matching the increased complexity of those most difficult flames will be our challenge.

We must improve our ability to THINK, as well as ACT, and to NETWORK at the appropriate levels. Our desire to shape the future of wildland fire management is based in our minds. It is important to understand what we know and what we don't know and be able to explain why. It is important to describe our limits, without being confounded or absorbed by our limits. We need to be able to see our future, be inspired and drawn to the vision of that future. We need to understand how to think and how to define the factors which frame our decisions.

To do this, we must continue our development of both doctrine and risk management tools applicable at the level of the individual, as well as the larger system. We need to develop more skill to deal with higher levels of complex wildland fire. Simple tasks will remain simple, as they have for centuries, but we must be prepared for the increasingly complex interaction of multiple variables in the wildland fire environment of the future. Multiple variables of the future include extraordinarily complex singular events, multiple events, and the interactions with and between each.

In addition to mental acuity, we must do a much better job at planning for and executing effective networking within our individual organizational hierarchies. Networking relationships may be more important than hierarchal relationships.

Networking is critical in wildland fire because the wildland fire profession will remain a niche profession. We will always be a small subset of the more than 1 million part-time, volunteer and career firefighters in America. We are different from our comrades in blue, who at times, share the same objectives. We are and will remain a visible and well-defined niche.

In our niche, we must develop a full-fledged profession—one founded strongly in and connected to both natural resource management and emergency management. Being linked to both, well versed in both, is our future. While we exercise our premier emergency management skills, wildland fire management MUST remain rooted in the land.

In our niche, with our connections, and to develop our profession, we need to develop philosophy. We will find our philosophers. Those wildland fire philosophers will remind us of the best of what we are. The best of what we are will be encapsulated by serving the great nation in which we live.

In addition to occupational philosophy, we must describe our ethics and standards. Once we've described those ethics, it will be up to us to enforce those professional standards.

Finally, there is a critical need to sustain and improve trust. We have an opportunity to be one of the most trusted professions in the world—that's our personal future. What follows is how I see us functioning within that future.

In the larger picture (the macro level), I see six specific items as being important—wildland fire related societal and climate trends; doctrine; mega-fire and its next iteration "asymmetric fire;" FIREWISE systems; measurement; and international cooperation. The intellectual, networking and professional foundations I've described provide the ability for us to be poised to be influential. We MUST retain the ability to be "periodically influential."

Societal and Climate Trends

I do not believe continuums define the future. Notable, usually catastrophic, events crystallize thinking and require an action. These notable events will be defined by and characterized by societal impacts—whether the society is large or small. Societies take note. Societies will note wildland fire but only periodically—when it directly impacts them, or those close to them. Our memories are short, and our optimistic outlooks allow us to endure misfortune. The fact that we as a society and as wildland fire professionals can "do something" with events that capture media interest, which are of the temporal nature, allow us to pay attention, and that are stimulating the senses, are all important. Wildland fire images are "newsworthy!" We are all fascinated by the flame.

In our future, there will be no interruption to the basic forces which have driven wildland fire management over the last 30 years in the United States and many other places in the world.

The increasing population, of specific note, that development in close proximity to wildlands, continues. If the recently published Headwaters Economics data on Wildland Urban Interface development is correct, think of the implications for us. How many houses can be or should be protected? Do we trade off burned or degraded wildlands for communities? Should we? Fires are a natural part of forested landscapes, but each year the fire seasons comes earlier and lasts longer. Fires burn hotter and bigger, which means more smoke and carbon in the atmosphere—more climatic change.

Choices are key. In our society, there is a reluctance to fully utilize domestic natural resources. The desire to conserve has become the choice to protect. The uninformed sense of our ability to achieve ecological stasis is one of the conundrums of our time. Wildland fire professionals must be part of the debate surrounding discussions about ecological stasis and the $100 barrel of oil. There is an increased desire and expectation to "do something." As much as we might like the legend, the self-reliant individual in the wilds has succumbed to the "dialed-in" visitor from the suburbs. The cries of "do something" will be more numerous and more fervent in the future. The fact that our actions often seem to accomplish the "do something" test is critical. Our ability to be able to answer "what can we do?" is very important, not only for the adults, but for the youth of the nation, as well. Our children need to understand how much they depend on forests, see the connection of natural resources to their homes and communities wherever they live—and 80 percent of our population lives in urban environments. Let me reiterate, our ability to be able to describe what we cannot influence and what we can is an important characteristic of the future.

These trends will continue another 30 years. I note these trends because I believe intelligent societies will not long accept incoherent actions. In wildland fire management, either we help establish a coherency of action at the local, state and federal levels or the uninformed will do so.

Doctrine

Today, we are in the midst of making and recognizing a doctrinal shift with wildland fire. The doctrinal transition from "overwhelming mass" applied to every fire to "speed, agility and focus" will continue. Make no mistake, I am not suggesting "overwhelming mass" will cease to be an objective for some fires, but I am suggesting that a variety of wildland and prescribed fire will benefit from application of a doctrine which considers "speed, agility and focus."

Small groups of highly-trained individuals will influence wildfire, fire use and prescribed fire. Our doctrine will recognize the influence of management actions ahead of time with specific actions during the event. We will learn how to influence the "flow" of fire. We will learn how to moderate the depth and intensity of the flow and how to reduce the energy of the flow. "Speed, agility and focus" will allow us maximum leverage in complex situations.

Mega-fire and Asymmetric Fire

Mega-fire and asymmetric fire—events with fire on the landscape, whether they be large prescribed fire, wildland fire use, or wildfire will garner attention. Remember the stimulation of fire to the public.

My friend, Jerry Williams, was right when he recognized mega-fire some years ago; and in the next 5 to 10 years, there will be more mega-fires. If we could consider fire as a fluid, perhaps as water, what we are doing now is damming the fire. We are allowing large pools, reservoirs of wildland fire energy to be accumulated. There is a tremendous energy wanting to flow out, but it can't easily because it is being dammed by the forces we convene. Eventually, the dam is breached and the energy—the fire-flows out. Fire then becomes "fluid," with a catastrophic energy release. It's interesting that we've not shown the societal will to mitigate the available energy at the source (wildlands), but the question that will continue to be posed is to how to deal with energy which bursts forth from the wildland.

As the mega-fire wanes (the relatively short, intense burst of energy) for a variety of societal and ecological reasons (including changing species composition and climate), the next challenge beyond mega-fire is "asymmetric" fire. I believe these are the fires which will challenge us in the next 5 to 20 years time frame.

Asymmetric fire will be a combination of fires ranging in size from "mega" to small, at a variety of times and places, some set by us for worthy purpose, most arising from a combination of miscellaneous causes and some developing from evil intent.

Our wildlands will become more flammable. Rising temperatures are leading to hotter summers, earlier snowmelt, declining snowpacks, and more water shortages, outbreaks of forest pests and diseases, and wildfires which are worsening. With increasing numbers of fire, both lightning and person caused and increasingly flammable vegetation, asymmetric fire will be characterized by frequent, highly dispersed, seasonally numerous events, in other words, multiple fires, in multiple places, over long periods of time.

There will be an even more critical need to define the fire we want, the fire we don't want, the fire we tolerate and the fire we encourage. Confusion will abound as cameras struggle to "define the flame." The challenges associated with these changes will not be resolved in a few years. It will take generations. Unless children of today and tomorrow understand why wildlands are so valuable, they will do little to protect them for future generations. The educational process must start at the lowest level.

There will be a bright side with tolerable or encouraged large landscape burns in times and places. The managerial side of asymmetric fire will be marked by intense competition for high valued assets. The dark side will be more person caused fires. With asymmetric fire, we will become more concerned about the influence of arsonists and terrorists as they utilize fire for nefarious means.

Because of these trends, wildland fire will assume a greater role and be a greater concern in homeland security discussions, both the threat and the risk will increase.

FIREWISE Systems

There will be more interest in moderating fire behavior and protecting citizen's, communities and systems. In the first QFR, we described fire adapted communities. This was a big step forward. We now need to make sure the community understands the wildlands around them. Whether it be fire adapted communities, fire safe councils or FIREWISE communities, we will be able to more effectively define the entire system—a system which not only includes development such as homes and infrastructure but ecosystems. How we accomplish changing the fundamental of the wildland fire energy or mitigating its effect is key to our future, especially with the increasingly intolerant urban citizenry escaping to the

wildlands. Eighty percent of our population lives in urban environments. The public, including our children, need to understand how much they depend on the forests, wherever they may live.

Measurement

In the future, large actuarial losses and continued demonstrations of the power of fire will capture the attention of the insurance industry and its regulators in the United States. Our job will be to help connect the insurance industry, people's homes, the community and the wildland surrounding them.

Actuarial attention will be difficult for us; because it will drive the need for investments based measurements not common to the wildland fire community such as return on investment (ROI), positive benefit/cost (B/C) ratios and better defined business practices.

International Cooperation

International cooperation will be increasingly common in the next 30 years. Specialized assets will move internationally across the globe, and contractual or "government to government" relationships and coverage of those assets will be as common as the US inter-regional agreements are today. Agreements and response systems will be structured to deal with global issues of wildland fire. Now that I've finished up with the world, let me lose some altitude quickly.

Quadrennial Fire Review (QFR)

The QFR points to nirvana—formulation of a national fire policy, not federal policy; but a policy which combines the interests of federal, state, and local governments, as well as the individual. There will be coherently defined roles and responsibilities. There will be rational national priorities. The QFR will be a major influence in the establishment of that national fire policy; and the national fire policy will serve as an anchor, as it leads to the international agreements which will come to fruition.

In summary, our actions will be driven by our thinking; our thinking will be defined by our spirit. I am looking forward to a journey marked both by our altruistic spirit and our creative, critical thinking.

Presented at the Fire Research Forum- November 6th, 2007 Washington, D.C. & Tucson, AZ

Purpose

The 2005 QFR Report focused on four sets of driving forces which would have altered the external environment of wildfire and consequently have the most impact on shaping fire management strategies in the future. The 2005 Report identified the following as the most significant driving forces for the future:

"Fuel accumulations stand as a significant causal factor for catastrophic fire. It is also fairly well accepted that biomass is accumulating faster than it can be treated. The situation is further complicated by the increasing problem of exotic evasive plant species. Even if the significant increase in fuel treatments at all levels of the past five years is sustained, it may only have limited effect in controlling the rise in wildland fire and reducing the impacts of extreme fire.

Directly linked to fuel is the predicted longer term – thirty year drought cycle that climatological data indicates the nation entered in the mid 1990's. This drought coupled with the possible effects of abrupt climate change and temperature warming will significantly impact various fuel regimes across the country. Areas, which have not traditionally witnessed large catastrophic fires, will begin to experience these fires as the fuel beds begin to adapt to drought and climate change.

Demographic shifts from metropolitan areas to rural areas also complicate the problem by putting more people into fire prone areas in the Wildland Urban Interface or Intermix. While some of the newer communities and housing have been created with wildfire defense in mind, far too many have not. They, along with many older communities and homes, have been established with inadequate regard to fire adaptability and survival.

Public focus is on protective measures, such as saving property and preserving the surrounding area, rather than defensive ones. This has diverted, and will continue to divert, firefighting resources from their primary suppression management mission into more hazardous suppression containment situations. The lack of human community fire resilience also limits the agencies' range of management responses to fires near communities.

What follows is a synthesis of trends, issues, and emerging challenges for the fire management community, its partners and stakeholders in the form of an advance briefing. This synthesis is primarily written for the QFR working panels that will be formed in the spring to look to the future and shape new alternatives and possible directions. The synthesis looks back on the assessments of the future made in 2005 and attempts to be projective (i.e. thinking in the future tense about what's most likely to change and what would have the most impact within future change). The themes identified in 2005 are no less important now but they are more interrelated than ever. The format is a brief discussion of the range of ideas reviewed during the research phase followed by a summary of driving forces that will most likely impact fire management in 2009 and the next two decades beyond.

Climate Change, Ecosystem Dynamics and the new scale of wildland fire in the United States, and indeed across the globe!

The 2005 QFR Review's prediction that the United States was entering into a new period of increased fire activity and larger wildfires has been realized all too quickly. Wildland fire activity, as measured by acres impacted, had been increasingly consistently since the mid-1980. While the fire season of 2000, the precursor to the National Fire Plan, was then noted as the "fire season of the century", the total acreage burned that year has already been eclipsed by subsequent fire activity in each of the last three years. Acres burned reached a new modern day record of 9.8 million acres in 2006.

Wildland fire activity prior to the turn of the century was considerably lower than it is now.

Wildland fire activity has reached a new plateau of around 7-9 million acres per year since 2005.

It is highly likely that the new plateau of 7-9 million acres will be exceeded and some years acres burned will be as high as 10-12 million.

Fire activity now is being compared in scale to the wildland fire seasons in the early 1900's that burned large acreages in the West. In the first half of this decade (2000-2004) the average annual acres burned by wildfire reached the 7-8 million range (all ownerships). Since the 2005 QFR, it is increasingly clear that the 7-9 million acres per year constitutes a new plateau.

Looking to the end of this decade, there is a high likelihood that wildland fire activity could exceed this new baseline and move up as high as 10-12 million acres due to the effect of climate change on wildland ecosystems.

The Effects of Climate Change

The effects of climate change will certainly vary from year to year and from one geographical area to another. This variability will create uncertainty in the amount and location of acres burned, but as mentioned, it is highly likely the total will be higher than the new plateau. It is also highly likely that wildland fires will occur in geographic areas that haven't traditionally experienced such events, such as the eastern part of the US.

Climate change will worsen the effects of extended droughts in various locations around North America. The Southwest, and now the Southeast regions of United States are expected to most severely experience the effects of the long term drought cycle) they have been in since the late 1990's. (Many experts, as the 2004 QFR report noted, see this drought period lasting 25—30 years). In terms of impact, drought will create competition for water on ecosystems, increasing the stress on biomass, and drying out vegetation. The latter will contribute to making fuels more flammable, increasing the risk of greater fire intensity and faster fire rate spread.

Climate change, specifically through the effects of global warming, will alter the majority of ecosystems in the United States. Ecosystems will change dramatically in structure, composition and distribution of species within the next 30 years. These changes will make disturbance from wildland fire inevitable,

managed or unmanaged. While climate change effects will exacerbate the level and frequency of wildland fires, the resulting change in fire regime will in turn significantly affect rates of change in ecosystems.

Larger Wildfire Fires and Mega-fires

Larger wildfires will continue to have a major impact on fire suppression strategy and cost. The 2005 QFR report predicted that there would be a significant increase in both the amount of fire activity and the number of large wildfires, even if the fire agencies sustained their Initial Attack success rate at over 95%. This trend has been realized. Since 2000, there have been over 60 large wildfires in the US and Alaska exceeding 100,000 acres compared to less than 20 in the previous decade.

While the definition of what constitutes a "mega-fire" is currently evolving, more states and national forests have experienced large wildfires over the last decade that set new historical size records. Ongoing project studies of mega-fire activity reveal that since the late 1990's in the U.S. there have been at least ten large, complex, and highly destructive wildfires that merit the label "mega-fire." These few extraordinary wildfires or Mega-fires have required an enormous suppression response, but still resulted in unprecedented loss and threats to private property, to say nothing of the resource damages that also occurred.

Large wildfires are increasingly longer term campaign fires that are costly and require multiple incident management team transitions. (In 2006, of the 20 large wildfires that exceeded the $10 million dollar cost threshold, 14 exceeded 30 days and 9 of those 14 exceed 45 days under national incident team management control). Larger wildfires are increasingly becoming a bundle of multiple fires occurring in the same area that are managed together as a "Complex" to improve use of limited resources. Larger wildfires also tend to cross administrative boundaries requiring that fires be managed cooperatively, sometimes by several agencies at the same time.

In terms of cost, since Congress added the requirement to conduct independent reviews of fires exceeding $10 million in cost, the number of such fires has risen annually; there were only 5 total in 2004-2005 while there were 20 during 2006, and 27 during 2007. These large, costly wildfires accounted for $500 million in FY 2006 and nearly $600 million if FY 2007, almost one third of the total expended on fire suppression during FY those years (FS only).

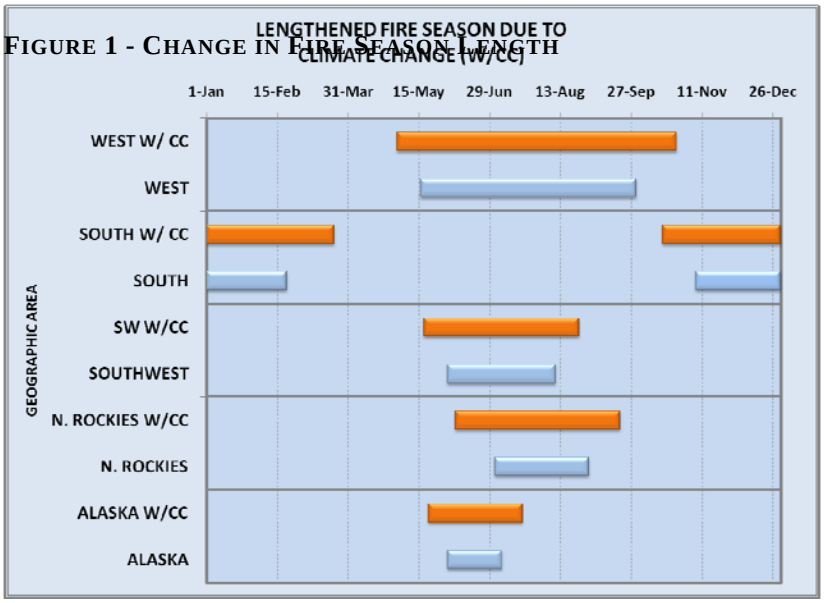


FIGURE 1 - CHANGE IN FIRE SEASON LENGTH

Other Impacts on Fire Management

The warming and drying effects of climate change will tend to increase the period of the year in which wildland fires occur. Studies already indicate that wetter and warmer winters followed by faster snow melt in the west have expanded the fire season horizon. It is highly probable that a month should be

added to the front and the back of the traditional fire season. Variations, of course, will exist geographically. Figure 1 displays some estimates of new fire season length by region.

What remains unknown, but is a subject of increasing interest, is the impact on climate change and lightening occurrence, especially in the West.

Wildland fire intensity and spread rates can be expected to get progressively worse as climate change influences affect vegetation and ecosystems. As these fire behavior characteristics increase, the difficulty of effectively fighting a fire increases and the size of the fire usually increases commensurately. In many instances in the last seven years, changed fire behavior characteristics have forced a shift in wildland fire fighting strategy from perimeter control to point protection. This trend is expected to continue.

New Metrics for Future Fire Management Effectiveness

As the costs of fire suppression have mounted since the National Fire Plan was implemented, concerns about cost containment have escalated. Issues of tactical economies and incident management accountability have been supplanted by larger strategic reviews of resource allocation and value protection. It is also apparent that new criteria will be incorporated into assessing fire management effectiveness, namely fire severity, landscape restoration, and carbon sequestration.

Increased fire activity, size, and intensity are already increasing pressure on fire management for a better understanding and measurement of fire severity. While the severity of a wildland fire is a direct function of the organic matter consumed, climate change increases the amount of organic matter available to be consumed and the risk to habitats and watersheds. Future wildland fires are going to increasingly have to factor in burn severity as a major factor in assessing ecosystem effects.

Closely related to this factor will be the impacts on landscape restoration, particularly when there is a conflict between native and invasive species. Insect and disease outbreaks have already increased dramatically as plants are stressed by climate change and species migration effects. Post-fire Restoration budgets, especially at BLM, are already reaching record levels in recent fire years.

Finally, the potential impact of new legislation and agency objectives on CO_2 emissions and carbon effects on global warming must be factored in. Wildland fire emissions are currently excluded from CO_2 emission calculations, but it is not yet clear where states will be on CO_2 emissions and wildfire suppression objectives. The USFS Chief's recently announced CO_2 sequestration initiative is another strategic opportunity for Fire Management to evaluate and integrate carbon management objectives into fire suppression and prevention strategies.

Nowhere is this potentially more significant than the boreal forest systems of Alaska. The major fires in black spruce forests, such as the more than 6 million acres that burned in 2004, contributed more greenhouse gas emissions to the atmosphere than are released from the combustion of all the oil that flows annually through the Alaska pipeline. Moreover,

The 6+ million acres that burned in Alaska in 2004 contributed more greenhouse gas emissions to the atmosphere than was released from the combustion of all the oil that flowed through the Alaska pipeline that year.

Large-scale fires in a western or southeastern state can pump as much carbon dioxide into the atmosphere in a few weeks as the state's entire motor vehicle traffic does in a year.

severe fires tend to convert boreal forests from coniferous forests that are the world's most effective ecosystem at sequestering carbon underground to broadleaf systems that are net contributors to atmospheric CO_2. Fire can also cause the release of centuries of stored underground carbon and destabilizes permafrost that contains methane, the most efficient greenhouse gas for warming the atmosphere.

Some forecasts are noting that climate change may raise the amount of acres burned in Alaska to unprecedented levels (between 10-20 million acres per year). Alaska may also be the case where national fire suppression strategies for the future needs to be woven into an international strategy to encompass Canada and Russia.

Climate Change, Ecosystem Dynamics - Summary of Driving Forces

- Wildland fire activity has reached the predicted new plateau of 7-9 million acres burned per year since 2005.
- It is highly probable that in future years (2010-2015) wildfire activity may reach a higher range at 10-12 million acres burned.
- Climate change will worsen the effects of extended droughts in various locations around North America, especially in the Southwest and Southeast U.S.
- Larger wildfires will continue to have a major impact on fire suppression strategy and cost. Since 2000, there have been over 60 large wildfires in the US and Alaska exceeding 100,000 acres.
- Mega-fires will also be a factor. Since the late 1990's, there have been at least ten large, complex, and highly destructive wildfires that merit the label "mega-fire." that have required an enormous suppression response, but still resulted in unprecedented loss and threats to private property and natural resources.
- Fire season length will continue to increase. It is highly probable that a month should be added to the front and the back of the traditional fire season. Variations, of course, will exist geographically.
- In this new era of large wildfires, changed fire behavior characteristics have forced a shift in wildland fire fighting strategy from perimeter control to point protection. This trend is expected to continue.
- It is also apparent that new criteria will be incorporated into assessing fire management effectiveness namely; fire severity, landscape restoration, and carbon sequestration.
- From the point of view of carbon management, fire management strategy might have to consider applying more effort to controlling and suppressing fires (i.e. Alaska in order to maintain and expand coniferous boreal forests).

Managing Resource Values and Sustaining Fire Dependent Ecosystems

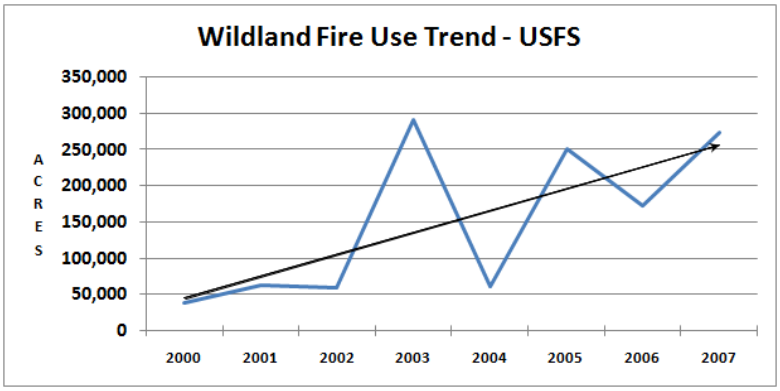
Since the adoption of National Fire Plan and the commitment of nearly $350 million annually in program funding, federal fuel treatments have grown to meet the target level of 3 million acres annually. This target was further amended in 2003 by requiring that 50% of the acres treated be in the Wildland Urban Interface. The resulting accomplishment has been the cumulative treatment of over 20 million acres on public lands since 2001.

Fuels Management Directions

Yet, as the 2005 QFR report noted, the fuels program has been outpaced by the continued growth in biomass and wildfire activity, further impacted by global warming factors. Fuels treatment in the United States which has averaged around 3 million acres per year by all federal agencies since 2001 has now increased to over 4 million acres with the inclusion of Wildfire Fire Use acres in the calculations. But even this level cannot meet the 10-12 million acres level of scale noted in the 2005 Report that would be needed to significantly reduce fire risk on current landscapes.

Further, there is little reason to think that current levels of treatment can be easily increased. Even if more funding were available, numerous legal, planning, and smoke issues contended with, the windows for operating a fuels programs, especially using prescribed fire, at greater levels is probably not there. In fact, it may be contracting further as the fire season expands.

There is an opportunity, a highly likely probability, that the wildland fire use program can be expanded to over 1 million acres (excluding Alaska). This would increase the fuel treatment program on the order of a third. Public acceptance of such a program is more likely to be obtained, particularly in areas which have experienced wildland fires in the past. Even with recognition that WFU is essential to ecosystem management, the planning necessary for wide spread use of WFU, or changes to existing policy that provides the flexibility for WFU is still in development.



Prescribed fire has probably reached its plateau at the current levels however. Budgets and external concerns (e.g. smoke) will continue to limit activity levels planned by the many agency units.

National commitment versus Regional capacity is another issue. While fuel treatments occur all over the United States, the Southeast still accounts for over 33% of the total fuel treatment in the US Forest Service since 2000.

Fuels Reduction vs. Fire Activity in the Large Fire Era

A fuels reduction total effort that treated over four million acres annually obviously would have fared better in an era where the 10 year annual acres burned averaged was 3.75 million acres from wildfire – as it was in the 1990's. In the current era of 7-9 million acres annually burned by wildfire, and growing, the rate at which ecosystems are being burned through wildfire far outstrips the amount of fuel treatments being accomplished through planned projects.

Essentially, the impact of these two facets of wildland fire management are an order of magnitude apart with wildfire essentially "treating" ecosystems at a much higher rate. While planned fuel treatments are being outpaced by wildfire, this does not mean that that there are not noted examples where wildfire activity stopped when it reached a fuels treated area or where burn severity was significantly reduced when burning through a treated area. Fire research efforts to assess how well fuels treatment efforts have worked, both in terms of limiting wildfire spread and decreasing fire burn severity, will have the potential to help land and fire managers realize greater return on fuels investments.

It remains desirable to maintain existing fuel treatment programs both in order to maintain agency capacity to accomplish such work and to strategically place fuels treatments in conjunction with fire activity.

Future alternatives for fuels management programs will want to consider blending three core strategies:

1. Placement of fuel treatments based on strategic risk management or habitat protection criteria for both the Wildland Urban Interface and to protect and enhance natural resources, such as important habitats or watersheds.

2. Leveraging fuels treatment through cooperative state and local government programs to incentivize community efforts and build "local" fuels management capacity via grant programs to state and local entities and establishing cooperative programs with willing and able neighbors

3. Build a future platform through subsidy and support of the nascent wood energy/ethanol industry for support of the federal goals of ethanol production from wood and moving towards intermixing fuels reduction biomass with other woody feed stocks and agriculture residue stocks.

Alternative 3 is partly derived from a recent proposal of the Forest Service Chief's office to replace 15% of the US gasoline consumption (more than 30 billion gallons) with wood-based ethanol. This represents a long-term strategic goal for fuels reduction programs as technology advances accumulate.

The rate at which ecosystems are being burned by wildfire is outpacing the amount of fuel treatments being accomplished through planned projects.

Future fuels management strategies will most likely be a blend of three programmatic alternatives:

1. *The current strategic placement of fuels treatments based on risk and resource values.*
2. *Emerging efforts to promote state and local community fuels efforts.*
3. *Future programs to support wood based ethanol production.*

In the view of the Research Advisory Panel's bio-fuels expert, wood-based ethanol will happen but it will be based on the lowest cost feedstocks. Urban woody waste and agriculture residues (orchards, pruning's, etc.) are on the low end of the cost scale while logging slash and fuel reduction biomass are on the high end. High costs of extraction, collection, and transport to processing facilities, as well as a guaranteed ten-year supply of material, are limiting factors.

To foster woody biomass use as an energy source and meet the future wood-based ethanol goals, the biomass must be located within 50 mile radius of the facility to be cost effective. Further, something on the order of 20-40 million acres of woody biomass per year from federal lands would be needed. While estimates indicate there is a substantial amount of forest derived bio-mass within the US, it is spread across the entire nation with Forest Service lands accounting for less than 5% of potential feedstock.

But the national commitment to ethanol as denoted in this year's energy bill might be viewed differently. Perhaps it's not how much wood based ethanol can be produced – but rather the strategic opportunity to subsidize the treatment of 12 million acres of forest derived bio-mass from public lands and an even larger amount from adjacent communities, for which the issue of what to do with "green waste" from mechanized thinning efforts constitutes a formidable obstacle to developing programs.

Managing Resource Values and Sustaining Fire Dependent Ecosystems - Summary of Driving Forces

- Current fuels treatment program efforts (prescribed fire and mechanized thinning) can and will be sustained at 3 million acres while also meeting the 50% target for acres in the WUI per the National Fire Plan Goal from 2007-2010.
- Wildland Fire Use – as currently included in the fuels management effort could reach 1 million acres annually (excluding Alaska). This could raise total fuels treatment acres to the 4-5 million acres range.
- Federal fuels treatment programs, at over 4 million acres per year, considering maintenance requirements will still lag significantly behind fire activity over the next decade.
- Smoke restrictions and other legal obstacles will continue to narrow windows for fuels treatment which will significantly limit broadening treatment efforts on larger landscapes making a higher goal of treating 8-10 million acres annually unrealistic.
- Regional variation in fuels efforts will continue with the Southeast maintaining its historical ability to dominate fuel treatment efforts.
- Future fuels treatment programs will likely be a blend of current programs emphasizing strategic placement of treatments, promoting state and local community program efforts, and building a future platform for the integration of fuels treatment into wood based ethanol production.
- While there will be increased state and local governments' and communities' recognition of the importance of fuels management goals, attempts to move community efforts to a new plateau and make a significant difference in reducing risk for high intensity wildfire activity will vary greatly because of budgetary limits and jurisdictional issues.
- More evaluation of fuels management programs in the larger context of sustaining fire dependant ecosystems will emerge (through the use of remote sensing data and pre- and post-fire effects

studies) that will help shape future strategies for strategic placement and decreasing severely burned acres with investments in fuel treatments.

Social Dynamics and Values for Public lands and the Interface

The 2005 QFR Report noted that demographic shifts – notably new population and housing – towards the Wildland Urban Interface would continue to accelerate in the first decade of the new century. This reflects both regional shifts in population and the increasing attraction of owning property for both seasonal recreation and full time residency in areas adjacent to the public lands (and in some cases where there are extensive in-holdings) inside the public lands. This trend has greatly complicated the mission of the fire management in protecting communities at risk from wildfires.

Slower but Mounting Rates of Growth in the WUI

For the next decade, (2010-2019) social scientists and demographers are predicting a somewhat slower rate of growth in the WUI. Nonetheless, another 5-6 million homes will be added to the nearly 9 million homes build in the Interface in the 1990s. Much of this will be in the West, where regional population growth already exceeds national growth rates and is on track to exceed 80 million people or 24% of the Unites States population by 2020.

Economic factors are expected to curb new WUI growth somewhat, as effects of falling housing pricing and home equity in the current economic slowdown are felt over the next several years. The surging cost of gasoline and utility costs may also limit developments of new residential developments. This will vary greatly by geographic region but growth in the WUI is likely to mount when better economic conditions resume.

These resulting demographic trends in the WUI, especially in high growth areas like the Southwest, Southeast and Southern California, will increase the probability of large wildland fires becoming significant WUI fires. Indeed, the 2006 Large Fire Cost Review panel noted in their assessment of the 20 most costly wildfires of that year (across five western states) that population (+13.6%) and housing (+9.8%) growth rates in the adjacent counties to these fires were actually increasing at higher rates than the 1990's.

Smoke and Public Expectations

As more studies are being conducted of the needs and expectations of residents in the WUI, two forces are already clear. The first involves aversion to smoke. Research shows that smoke will be an increasing health factor in the WUI as 30-35% of households in the WUI have smoke related health issues. This is also true of smaller communities and cities as well as the WUI, who may be subject to smoke effects from prolonged wildland fires.

Secondly, the Interface and the Intermix will further diverge with more home construction and settlement away from new and old communities which will create a higher proportion of homes in the Intermix rather than the Interface. The larger growth in the Intermix will present challenges for fire management programs requiring some organized community element.

Helping Communities Adapt to Wildfire Risk and Public Education

Current efforts to promote fire prevention efforts in communities will continue. More Communities will adopt CWPP's – but they will be more like compacts – i.e. agreements and protocols. Future budget

outlooks, even for those states with increased population growth, does not bode well for more self-financed fuels management and fire prevention programs.

Research indicates that community expectations are changing. There is more awareness of the risks and the limitations of what any government entity can do to suppress wildfires. Indeed, very recent trends are likely to escalate in the Media coverage of the WUI fires that shift the emphasis to personal risk as opposed to public responsibility for resident decisions to live in potentially dangerous fire zones. The WUI may well become synonymous with "the Fireburbs" as there's more awareness of the potential wildfire threat in this new era of large wildfires.

Fire management can likewise expect to contend with property owner expectations shifting towards increasing ability to stay and defend property or fire-proofing homes and not having to evacuate. Community attitudes are already shifting to increasing in support of prescribed fire and thinning programs for fuels reduction. Likewise, community attitudes about suppression strategies and AMR will be more supportive as level of fire activity increases.

Social Dynamics and Values for Public lands and the Interface - Summary of Driving Forces

- Rates of growth in the WUI in the next decade (2010-2019) will slow – but another 5-6 million homes will be added in areas adjacent to the public lands, especially in the West. Western population growth will continue to exceed national growth rates.
- Negative economic factors will affect WUI growth generally, but only temporarily. The Interface area, especially, in high growth state areas like the Southwest, the coastal states in the Southeast, and Southern California will make nearly every potential large wildland fire a WUI fire.
- Smoke will be an increasing health factor in WUI because a significant percentage of households in the WUI have smoke impacted health issues.
- The Interface and the Intermix will further diverge increasing the existing trend of a higher proportion of homes located in the Intermix rather than in organized interface communities.
- More Communities will adopt CWPP's – but they will be more like compacts (i.e. agreements and protocols). Commitments to start and sustain fuels treatment programs or regulate landscape development will continue to lag.
- Media perception and coverage of the risk of living in the "Fireburbs" will emphasize personal risk as opposed to public responsibility for decision to live there. Still, public responsibility will continue to dominate as long as governments tax for the privilege to protect the public.
- Property owner expectations will shift towards increasing ability to stay and defend property or fire-proofing homes and not having to evacuate.
- Community attitudes will shift towards increasing support of prescribed fire and thinning programs for fuels reduction, but smoke regulations and funding issues will still be significant deterrents.
- Community attitudes about suppression strategies and AMR will be more supportive as level of fire activity increases and federal and local authorities collaborate effectively on emergency notification and evacuation procedures.

Technology

The second part of the Fire Research Forum was dedicated to identifying major challenges to current assumptions in fire management from fire systems and technology changes. Several researchers spoke at the forum about new systems, technological advances, and radical innovations in development that will impact many aspects of fire planning, prevention, and suppression operations and tactics.

These themes will be revisited in an addendum to the advance briefing report in early spring to focus on the core themes the QFR working panels address.

APPENDIX

Table 1 – Acres Burned By Wildfire

YEAR	FS	DOI	AK	Total
1980	377,645	709,094	364,940	1,086,739
1981	322,926	1,234,319	572,143	1,557,244
1982	82,900	285,683	71,857	368,583
1983	80,510	758,917	162,039	839,426
1984	187,779	1,189,456	114,858	1,377,235
1985	740,970	2,076,305	372,784	2,817,275
1986	405,343	1,007,542	395,374	1,412,885
1987	1,292,592	938,386	156,494	2,230,978
1988	3,584,260	1,910,535	2,134,539	5,494,795
1989	595,870	875,616	64,810	1,471,486
1990	562,254	884,815	3,189,079	1,447,069
1991	194,085	324,308	1,667,950	518,393
1992	721,205	869,300	150,006	1,590,505
1993	330,423	540,102	712,868	870,526
1994	1,646,251	1,664,669	265,709	3,310,920
1995	376,210	830,593	43,933	1,206,803
1996	1,365,074	2,912,244	599,267	4,277,318
1997	240,948	424,684	2,026,853	665,632
1998	311,719	549,915	120,752	861,634
1999	1,088,357	3,179,215	1,005,428	4,267,572
2000	2,623,304	2,717,122	756,296	5,340,426
2001	746,353	1,515,384	216,039	2,261,737
2002	2,199,584	1,750,147	2,186,654	3,949,732
2003	2,019,991	2,152,553	602,678	4,172,544
2004	644,151	391,154	6,590,140	1,035,305
2005	1,154,482	3,217,617	4,663,819	4,372,098
2006	2,539,534	3,846,131	266,260	6,385,665
TOTAL	26,434,719	38,755,806	29,473,567	65,190,525

Table 2 – Fuel Treatment by Type and Agency

YEAR	TYPE	INTERIOR	USFS-R8	USFS-OTHER	TOTAL	% of TOTAL
2003	WUI	414,409	759,968	275,460	1,449,837	59.2%
	NON-WUI	695,090	118,223	186,131	999,444	
	TOTAL	1,109,499	878,191	461,591	2,449,281	
2004	WUI	474,322	985,303	582,120	2,041,745	57.4%
	NON-WUI	725,462	191,701	595,889	1,513,052	
	TOTAL	1,199,784	1,177,004	1,178,009	3,554,797	
2005	WUI	560,051	918,622	512,838	1,991,511	55.5%
	NON-WUI	830,541	252,898	516,070	1,599,509	
	TOTAL	1,390,592	1,171,520	1,028,908	3,591,020	
2006	WUI	479,322	766,310	531,769	1,777,401	56.4%
	NON-WUI	648,348	159,057	566,565	1,373,970	
	TOTAL	1,127,670	925,367	1,098,334	3,151,371	
2007	WUI	572,398	635,130	322,276	1,529,804	55.0%
	NON-WUI	729,611	242,997	276,679	1,249,287	
	TOTAL	1,302,009	878,127	598,955	2,779,091	

Table 3 – Fuel Treatment by Treatment Activity and Agency

YEAR	ACTIVITY	INTERIOR	USFS-R8	USFS - OTHER	TOTAL	% of TOTAL
2003	Rx FIRE	779,258	877,423	292,613	1,949,294	79.6%
	MECH	330,241	768	168,978	499,987	
	TOTAL	1,109,499	878,191	461,591	2,449,281	
2004	Rx FIRE	827,023	1,071,710	509,986	2,408,719	67.8%
	MECH	372,761	105,294	668,023	1,146,078	
	TOTAL	1,199,784	1,177,004	1,178,009	3,554,797	
2005	Rx FIRE	881,552	1,048,513	421,050	2,351,115	65.5%
	MECH	509,040	123,007	607,858	1,239,905	
	TOTAL	1,390,592	1,171,520	1,028,908	3,591,020	
2006	Rx FIRE	663,027	720,994	491,733	1,875,754	59.5%
	MECH	464,643	204,373	606,601	1,275,617	
	TOTAL	1,127,670	925,367	1,098,334	3,151,371	
2007	Rx FIRE	890,505	874,528	441,091	2,206,124	79.4%
	MECH	411,504	3,599	157,864	572,967	
	TOTAL	1,302,009	878,127	598,955	2,779,091	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