



Cumulative Watershed Effects of Fuel Management in the Western United States

CHAPTER 1.

Introduction to Synthesis of Current Science Regarding Cumulative Watershed Effects of Fuel Reduction Treatments

Douglas F. Ryan, *Aquatic and Land Interaction Program, Pacific Northwest Research Station,
USDA Forest Service, Olympia, WA*

Introduction

This report was produced by a group of scientists who were invited by the U.S. Forest Service to synthesize the current scientific literature to answer an important question facing the managers of federal and private lands in many parts of the country. The question was: What potential cumulative environmental effects at the watershed scale might be caused by implementing land management activities that reduce forest fuels on large scales? The main body of this report is a compilation of what they found, including both what can and cannot be concluded from the current science.

The scientific principles reviewed in this report are intended to be general. The examples of fire environments, land management practices, and vegetation types are drawn primarily from the western continental United States, roughly the region west of 100° W longitude. A follow-up report is planned to address the same question but with a focus on examples from the Eastern section of the continental United States (Lafayette and others, under review).

In this chapter, I broadly describe fuel reduction treatments on wildlands and the concept of analyzing cumulative watershed effects. For perspective, I have referred to some of the primary legislative and policy direction that influences the way that federal land managers apply fuel reduction treatments and analyze cumulative effects.

Fuel Reductions Treatments and Policies and Laws Related to Them

Fuel reduction treatments are land management actions taken to reduce the threat posed by severe and/or intense wildland fire by manipulating live and dead vegetation to reduce the loading of fuel on the landscape that can support wildland fire. Fuel reduction can be accomplished in a number of ways with the most common involving mechanical removal of fuel material (usually brush or trees) and/or consumption of fuel using prescribed fire. These two types of treatments may be applied alone, sequentially, or in

various combinations. Treatment of wildlands to reduce fuel was given a national mandate when Congress passed the Healthy Forests Restoration Act of 2003 (P.L. 108-148) (HFRA). Efforts to reduce the risk of severe wildland fire may receive additional impetus from studies that attribute recent increases in the frequency of large wildland fires to changing climate (Westerling and others 2006), raising the possibility that this threat may further increase in western forests with expected climate changes in future years.

To effectively reduce the risk of wildland fires, fuel reduction treatments will need to be applied to large areas of federal lands each year in the form of mechanical fuel removal and/or prescribed fire. In most cases, vegetation can regrow after treatments, meaning that, in many areas, maintaining low fuel stocking will require repeated treatments to reduce fuel stocking at intervals ranging from several years to a few decades. Where they are well designed and implemented, fuel reduction treatments will probably create a relatively low intensity of disturbance, for example, by disturbing only a small amount of surface soil per acre. However, because they will be carried out over many acres each year and entail return treatments at regular intervals, there remains the possibility that local, project-level impacts of fuel reduction treatments may add up to significant impacts at larger watershed scales and thus result in cumulative effects. These cumulative effects on watersheds might be caused by activities directly related to removing fuels (for example, felling, skidding, and/or chipping to mechanically remove fuel and/or prescribed fire to consume it). Cumulative effects might also include impacts of operations or infrastructure that support fuels reduction that may occur in areas at some distance from the actual site of fuel reduction. Examples of these supporting functions could include the movement from logging, fire control, and other vehicles used in fuel management. Examples of supporting infrastructure could include roads that provide access to large areas of the landscape where fuel management activities take place and the drainage ditches, culverts, and stream crossings associated with roads.

In recognition of the critical role of wildland fire in forest ecosystems and the risk that high fuel loads pose in forests, Congress and the Forest Service have taken several actions to accelerate fuel reduction treatments. Several policy initiatives by the Forest Service and other federal agencies (Federal Wildland Fire Policy of 1995, the Cohesive Fire Strategy of 2000, National Fire Plan of 2000, and Ten-year Comprehensive Strategy and Implementation Plan of 2001/2002) were strengthened when the President announced the Healthy Forest Initiative (HFI) (White House 2002). HFI streamlined administrative procedures required to implement fuel reduction treatments, including approval for using the Categorical Exclusion for fuel reduction treatments, a process for complying with the National Environmental Policy Act of 1969 (P. L. 91-190) (NEPA) that reduces the documentation required for planning these activities. In addition, HFRA reduced the number of alternatives that must be considered in NEPA analysis and added specific public involvement and collaboration requirements. Although these initiatives streamlined consideration of fuel reduction treatments under NEPA, they did not exempt these treatments from the requirements of the Act.

What Are Cumulative Watershed Effects?

When a federal agency proposes a land management action, its potential cumulative environmental effects must be considered, along with direct and indirect effects, and documented in a public report that the proposing agency prepares to comply with the NEPA. This report may be an Environmental Impact Statement (EIS), Environmental Assessment (EA), or Categorical Exclusion (CE), depending on the nature of the action and the likelihood of significant effects. Thus, to comply with NEPA, cumulative effects are among the environmental impacts of proposed major federal actions and any alternative actions that federal agencies must present for public review.

The basic concept of a cumulative effects analysis is to identify and consider the total effects of actions that overlap temporally or spatially and might be missed by

evaluating each action individually. The goal of cumulative effects analysis is to provide government decision makers and the public considering proposed federal projects with comprehensive information about “the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions” (40 CFR 1508.7). In general terms, cumulative effects may arise from single or multiple actions that may result in additive, interactive, direct, or indirect effects. Cumulative watershed effects are the net impact on watersheds of multiple management activities that may coincide geographically and temporally.

Although cumulative effects are defined by NEPA, concepts related to cumulative watershed effects also come into play in the application of other more restricted environmental laws. The Clean Water Act of 1972 (P.L. 92-500) (CWA) requires that both point sources (in other words, having a readily identifiable origin) and nonpoint sources (such as, lacking a readily identifiable origin) of water pollution be controlled, especially in waters that have been designated by states as not meeting water quality standards under section 303b of CWA. A common reason that nonpoint sources are not easily attributable to distinct locations is that they are spatially and/or temporally dispersed and thus may be the result of cumulative watershed effects. In addition, the Endangered Species Act of 1973 (P.L. 93-205) (ESA) protects species that are at risk of extinction (listed under the Act as “threatened” or “endangered”) from actions by federal agencies that could reduce the number of these organisms or their habitat. Where species listed under ESA dwell in aquatic or riparian habitats, these species or their habitat may be at risk from multiple management activities occurring at a watershed scale, that is, as a result of cumulative watershed effects. These examples are not exhaustive. Laws such as the Clean Air Act of 1970 (P.L. 91-604), National Historic Preservation Act of 1966 (P. L. 89-665, section 106), and others have requirements of their own that, under some conditions, may call for a cumulative effects analysis. If, for a given landscape, the consideration of cumulative watershed effects for complying with multiple laws becomes an issue for fuel reduction treatments or other land management practices, a more comprehensive watershed-scale analysis that meets the requirement of all these laws simultaneously might be warranted. This synthesis could provide a scientific basis for developing such a comprehensive watershed analysis to address multiple laws should federal land managers find it necessary.

Evidence of Cumulative Watershed Effects

Implementation of fuel reduction treatments at large scales has only begun recently so direct evidence of its cumulative watershed effects is likely to be scarce. However, cumulative effects of other land management activities have been measured at watershed scales. A classic example comes from a study of fish habitat in streams from across the Columbia River Basin (McIntosh and others 2000). In this study, habitat for anadromous fish in 122 streams that had been originally surveyed in the 1930s and 1940s was remeasured in the 1980s and 1990s. With the exception of streams in roadless watersheds, the prime habitat features in these streams showed significant losses over the intervening 60 years (for example “large pools” decreased by 24% and “deep pools” decreased 65%). An analysis of land management practices in these watersheds showed that no single practice or project was clearly responsible for the loss of habitat in these watersheds. Instead, they found that a wide spectrum of land uses had occurred within the watersheds of the degraded streams, including forestry, grazing, urbanization and road construction. It was the aggregate impact of all these practices, that is, the cumulative effect of all the land uses that had caused the habitat loss. By comparison, in watersheds with little or no change in land use over the period (which the authors represented by examining watersheds with no roads), aquatic habitat condition had remained constant or improved, reinforcing the conclusion that cumulative effects of multiple land management activities had caused the degradation. The lesson from this study for large-scale fuel management is that wide-spread land management

activities have the potential to cause significant, real impacts on aquatic systems even where the impacts of individual local projects may be small or difficult to measure.

Considering Cumulative Watershed Effects in Fuel Management

It is critical that cumulative watershed effects be considered early as part of planning and implementing fuel reduction treatments in the current legal and policy environment. Under HFI and HFRA, NEPA analysis is not waived. HFRA streamlined NEPA analysis by reducing the number of alternatives that must be considered and added requirements for public collaboration, but did not exempt or waive any projects from NEPA analysis. While HFI included Categorical Exclusions for fuel reductions treatments, the intent was to use an approach that more efficiently complies with NEPA requirements and likewise does not waive consideration under NEPA. Although a brief discussion of NEPA requirements follows, it is the purpose of this synthesis to assess what valid scientific information is available to assess the cumulative watershed effects of fuels reduction treatments, rather than explain in detail the legal requirements for documenting these effects. Planning teams may use information in this report to produce environmental documents at the appropriate level.

On National Forest lands, the forest planning rule approved in 2008 required that forest plans be written at a broad strategic scale. The Forest Service has determined that, at this broad scale, forest plans do not have environmental effects. Therefore, forest plans qualify for a Categorical Exclusion and do not require documentation in an EIS. As has been previously true, NEPA analysis will continue to be done for individual projects that are on the scale at which ground-disturbing activities are analyzed. In determining the scope of a proposed action, and the level of NEPA analysis needed, it is the responsible public official who is required to consider the action's environmental effects, including direct, indirect, and cumulative impacts (see 40 CFR 1508.25). In other words, the responsible public official decides the appropriate level of detail for the cumulative watershed effects analysis for the fuels reduction project(s) in question. Under the 2008 planning rule, site-specific actions are required to comply with NEPA, and cumulative watershed assessments will be a key part of the strategic resource decisions on these forests in the future.

The Council on Environmental Quality (CEQ) gave guidance on when to include cumulative effects in NEPA analysis (CEQ 1997). A recent memo (CEQ 2005) stated that "except in extraordinary circumstances, proposed actions that are categorically excluded from NEPA analysis do not involve cumulative effects analysis." This means that to be categorically excluded, a project must fit within specifically defined categories and must not involve extraordinary circumstances. For the Forest Service, extraordinary circumstances are defined as the degree of environmental impact to seven specific resource conditions listed in the Forest Service Handbook 1909.15, chapter 30, section 30.3. Fuel reductions treatments that meet these requirements may not have to undergo detailed cumulative watershed effects analyses.

Ultimately, it is the responsibility of the leadership and employees of the agency to find a balance between the broad set of laws and policies designed to produce the intended effect of protecting the public from wildland fire, while at the same time complying with other sets of laws intended to protect natural resources and the environment. If members of the public disagree with the balance that is struck, they have the right to challenge these management decisions through administrative procedures in the courts where these differences will be resolved.

Within this changing legal and policy arena, tools for analyzing cumulative watershed effects are likely to remain important for managers of natural resources. Cumulative effects are real, and sustaining multiple natural resources over the long run will require that they be considered. Streamlining requirements for analysis under NEPA or other rules assumes that these practices have impacts that are either insignificant or small compared to the long-term benefits from the proposed action. Courts and public opinion will likely

place the burden on land managers to demonstrate that those assumptions are valid. The standard for showing that kind of validity usually requires predictions that are supported by the current science.

The Need for Science-Based Decisions

The unprecedented scope and scale of fuels reduction treatments being undertaken by Federal land managers also makes a strong argument for developing available and scientifically based tools to estimate their potential cumulative effects. A recent, tragic example illustrates the vital role that tools play in bringing scientific information to bear on large scale problems. An analysis of the structural failure that caused the collapse of the World Trade Center Towers (WTCT) on September 11, 2001 was presented on Public Television (PBS, 2002). Paradoxically, the analysis showed that the buildings were not brought down by the physical impact of the airplanes that crashed into them. Instead, the buildings failed because of damage caused by the heat of the subsequent fires that were fueled primarily by the contents of the building themselves and not by the aircraft fuel that had only served to start the fire.

In an interview, the lead engineer who designed the buildings pointed out with some pride that at the time they were designed, the WTCT were not only the tallest buildings ever constructed but were also the first designed to withstand the physical impact of a large airplane. His design had succeeded to the degree that the initial impacts had not brought the buildings down. When asked why the buildings had failed to survive the effects of the subsequent fire, the engineer admitted that he was not able to consider the effects of such a fire in the buildings' design. At the time, there were no models available of how a fire of that magnitude would affect the structure of such a large building. In effect, the science of building fires was not available in the form and format (that is as a useful tool) that would permit practitioners to use it to evaluate this critical question at the scale of the problem they faced. The lesson from this example is that when decision makers must tackle projects outside of the previous scope and scale that they have experienced, the relevant body of science, where it exists, may be of little practical use if it has not been interpreted and articulated as tools that are directly useful for addressing problems at the proper scale.

Applying this lesson to fuels reduction treatments, land managers are planning these treatments at unprecedented geographic and temporal scales. If tools based on current science are not available, it is possible that planners and managers may not be able to include cumulative watershed effects in a meaningful way in designing and implementing fuel reduction treatments. Alternatively, if courts decide that fuel reduction treatments cannot proceed unless adequate cumulative watershed effects analysis are part of their planning, these treatments may be delayed until useful tools are developed that incorporate the latest science. In either case, developing tools that predict cumulative watershed effects of fuels reductions based on current science will be important.

Potential Uses of This Synthesis

This synthesis of the current literature on cumulative watershed effects is a first step toward developing useful tools for managers to consider these effects when planning and implementing fuel reduction treatments. It assembles in one place the current state of thinking that was previously scattered across many outlets in the scientific literature. At the minimum, it should provide managers, planners, and policy makers with a place to start when they have questions about this topic.

This synthesis, however, goes beyond being a central source of scientific information on this subject. Although cataloging and summarizing the literature are useful, this report tries to go further to anticipate questions that are likely to be posed by managers, planners and policy makers by asking them of the literature. By doing this, the audience can be informed about what relevant questions the current science can and cannot answer. The

“science gaps” are at least as important as the current knowledge because it is in these gaps that management and policy may lack science for guidance. These are areas in which managers and policy makers should be cautious because the outcomes of their actions in these areas may not be reliably predicted with a scientific basis, produce unforeseen outcomes, or be vulnerable to legal challenges. Identifying critical knowledge gaps also performs an important function for the science community. Future research and development that fill these gaps could potentially have a high payoff for managers and policy makers. This science synthesis may only be a first step toward providing useful tools. If managers, planners, or policy makers find that they need more detailed or explicit tools, the peer-reviewed knowledge gathered in a synthesis can provide an information base from which to start developing tools that meet those further needs.

The value of this synthesis will depend strongly on how well it reinterprets existing knowledge in the face of a new question. While it is true that a synthesis of the current literature may be a reworking of existing information, asking new questions of old data often casts them in new light. When done thoughtfully, new questions may suggest new insights that have not previously been considered. The questions considered here are indeed new because they involve the implications of a new management practice being imposed on the landscape at unprecedented scales of space and time.

Conclusion

In the end, this synthesis will be judged by its usefulness to future policy and management decision makers and as a starting point for future researchers and tools developers. We will leave it to you, our readers, to decide how well this document meets your particular needs. As you use this document, if you find other pressing questions that we did not anticipate or address, we urge you to ask the science community to answer them. If this report is used in these ways, it will have served its purpose to advance the state of land management and policy making and set the stage for future research and tools development.

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