Final Report

Analysis of Small-Diameter Wood Supply in Northern Arizona


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Forest Ecosystem Restoration Analysis

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1 Executive Summary

Forest management to restore fire-adapted ponderosa pine ecosystems is a central priority of the Southwestern Region of the USDA Forest Service. Appropriately-scaled businesses are apt to play a key role in achieving this goal by harvesting, processing and selling wood products, thereby reducing treatment costs and providing economic opportunities. The manner in which treatments occur across northern Arizona, with its multiple jurisdictions and land management areas, is of vital concern to a diversity of stakeholder groups. To identify a level of forest thinning treatments and potential wood supply from restoration byproducts, a 20-member working group representing environmental non-governmental organizations (NGOs), private forest industries, local government, the Ecological Restoration Institute at Northern Arizona University (NAU), and state and federal land and resource management agencies was assembled. A series of seven workshops supported by Forest Ecosystem Restoration Analysis (ForestERA; NAU) staff were designed to consolidate geographic data and other spatial information and to synthesize potential treatment scenarios for a 2.4 million acre analysis area south of the Grand Canyon and across the Mogollon Plateau. A total of 94% of the analysis area is on National Forest lands. ForestERA developed up-to-date remote sensing-based forest structure data layers to inform the development of treatment scenarios, and to estimate wood volume in three tree diameter classes of <5", 5-16", and >16" diameter at breast height (dbh, 4.5' above base). For the purposes of this report, the group selected a 16" dbh threshold due to its common use within the analysis landscape as a break point differentiating "small" and "large" diameter trees in the ponderosa pine forest type. The focus of this study was on small–diameter trees, although wood supply estimates include some trees > 16" dbh where their removal was required to meet desired post-treatment conditions.[4] There was no concurrence within the group that trees over 16" dbh should be cut and removed from areas outside community protection management areas (CPMAs).

Participants successfully defined desired post-treatment conditions within five landscape management areas that included: communities, municipal and aquatic species watersheds, Mexican spotted owl (MSO) restricted habitat and wildlands. Consensus was reached across two-thirds of the analysis area. The group unanimously agreed that 26% of the 2.4 million acre

[4] Desired post-treatment conditions refer to the working group's preferred conditions following restoration treatments. They are not equivalent to desired conditions defined in the National Forest Management Act.

analysis area should not be considered a source of wood supply from mechanical restoration treatments, due to institutional and biophysical constraints. Consensus was also reached on the appropriateness of restoration treatments involving mechanical thinning across 41% of the landscape, resulting in a total of 850 million ft^3 of wood byproducts from tree boles alone (defined as the tree's main stem, from the ground to top of tree), and an additional 8.0 million green tons from branches and other tree crown biomass. All mechanical thinning treatments were assumed to be followed by controlled burning for ecosystem restoration and maintenance of fire-adapted conditions. The volume of small-diameter logs and wood byproducts potentially available from restoration treatments exceeds current market demand. In 2006 existing wood products businesses in the analysis area removed and utilized 1.2% of the bole biomass (or 12% extrapolated over 10 years) that would potentially be generated from consensus scenario treatments.

There is a high level of agreement, but not consensus, that an additional 33% of the analysis area might also be available as a source of wood supply from mechanically-based restoration treatments. When added to the byproducts from the consensus scenario, this would result in a total of 1,015 million ft^3 from boles and 9.6 green tons from tree crowns. The difference between the two scenarios was relatively small in terms of wood volume and largely driven by preferences for varying levels of restoration treatments, such as the preference of some stakeholders for prescribed burn-only treatments, wildland fire use[5] and non-commercial thinning (or thinning that would not add to wood supply). The analysis also revealed that where wood harvest included only trees under 16" in diameter, 19% of the landscape with restoration treatments would not fully achieve desired post-treatment conditions, as identified by the working group. These thinning areas were primarily within CPMAs where objectives called for more aggressive thinning.

The group considered incorporating future tree growth in wood supply assessments, but ultimately did not pursue this analysis, however a review of forest growth models was conducted to assist with future projections. Consequently, the numbers presented in this report represent a "snapshot" of currently available wood supply. Lack of complete data on current road access, the presence of archeological sites, and other site-scale considerations introduce some uncertainty in

[5] "Wildland fire use is the management of naturally ignited fires to achieve resource benefits, where fire is a major component of the ecosystem" (source: http://www.fs.fed.us/fire/fireuse/wildland_fire_use/use_index.html).

wood supply estimates. Potential changes to future wood supply due to climate change and disturbances such as wildfire, insect outbreaks, and drought-related mortality were also acknowledged. The results of this study will be used to assist in the development of multi-year forest stewardship contracts to attract new industrial users and to supply wood fiber to existing local wood product businesses.

2 Project Background

The Analysis of Small-Diameter Wood Supply in Northern Arizona (referred to as the "wood supply analysis") was initially called for in the fall of 2006 by an *ad-hoc* group of forest restoration professionals in Arizona and New Mexico. Concerns were mounting over the lack of funding for restoration treatments and a need for information regarding the volume of wood that might become available to existing and proposed wood utilization facilities, as byproducts from forest restoration. At the request of the *ad-hoc* group, our applied research team in the Forest Ecosystem Restoration Analysis (ForestERA) Project at Northern Arizona University submitted a proposal, later funded by the USDA Forest Service, Southwestern Region (Region 3), to estimate the supply of wood byproducts stemming from one or more ecologically appropriate treatment scenarios. Treatment scenarios were to be developed collaboratively by a diverse stakeholder group. Five members from the *ad hoc* group formed a steering committee to advise the collaborative process, public outreach, and other aspects of the project.

This report summarizes the work completed on the project, which officially began in May of 2007. Project deliverables specify that the ForestERA Project:

- Fully engage agency representatives and stakeholders in a collaborative process to build agreement on ecologically appropriate map-based treatment scenarios
- Mobilize the best-available science to quantify wood volume by size-class across the analysis area
- Estimate the volume of wood byproducts removed following each treatment scenario
- Review and recommend methods for estimating future net growth
- Prepare a database of existing wood harvesters, processors, and users

The analysis area includes ponderosa pine-dominated lands within selected National Forest boundaries in north-central Arizona (Figure 1); it does not include mixed conifer, pinyon-juniper, or other forest types. The area is located south of the Grand Canyon and spans the full

extent of the Mogollon Plateau to the border of New Mexico. The extensive and contiguous ponderosa pine-dominated areas on White Mountain Apache lands south of the analysis area are not included in this study, although they constitute a potential future source of wood byproducts.

This study offers a snapshot in time (year 2006) of both wood volumes across the study area and the range of wood byproducts that stakeholders agree could potentially be harvested. The wood supply working group (described below) decided early in the process to consider only treatments harvested mechanically as a source of wood supply, in order to simplify the development of their treatment scenarios, given that the vast majority of thinning treatments would likely be carried out with mechanized equipment. In addition, all mechanical thinning treatments were assumed to be followed by broadcast burns for the purposes of ecosystem restoration and maintenance. Analysis of wood supply for this assessment was implemented at a semi-regional scale (2.4 million acres of ponderosa pine dominated lands embedded within the proclamation boundaries of all or part of 4 USDA National Forests covering a total of 5.9 million acres) and should not be considered as a proposal for National Environmental Policy Act (NEPA) analysis. Site-specific analyses will be required to address the complexity of land planning issues that arise as thinning projects are developed on a case-by-case basis.

The overall objectives of the working group's treatment scenarios match the USDA Forest Service "Central Priority" for the southwest of restoring the health of fire adapted ecosystems. It supports the second and third components of the strategy to "reduce the threat of catastrophic wildfire to communities" and "reduce treatment costs by fostering private sector involvement to create the infrastructure to utilize excess biomass" (USDA Forest Service Southwestern Region, "Southwestern Region Central Priority: Restoring the Functionality of Fire Adapted Ecosystems", p. 23). It is also consistent with Arizona Governor Napolitano's "Statewide Strategy for Restoring Arizona's Forests" (Governor's Forest Health Councils, 2007). The Southwestern Region plans to use this study to assist them and others in assessing the appropriate scale and scope of restoration treatments and the infrastructure for utilizing forest biomass produced as a byproduct of these treatments (Forsgren, 2007a; see Appendix A of this report).

3 Building Agreement on Treatment Location and Type

A primary goal of the wood supply analysis was to build agreement among stakeholders in the region on the location and type of restoration treatments to improve forest health and protect communities from wildfire. To accomplish this goal, we formed a 20-member working group and held a series of meetings using a participatory geographic information system (GIS) process to develop map-based treatment scenarios. We also provided opportunities for a much larger group of interested parties from outside the working group to record their comments in the meeting summaries and make a case for various aspects of scenario development of importance to them.

3.1 Wood Supply Steering Committee

Five stakeholders served on a project steering committee, which guided the preparation of the funding proposal and the design of the collaborative process. The committee met once between each working group meeting to review meeting progress and advise planning for the next meeting. This project would not have been initiated or possible without the interest and perseverance of this committee and the *ad hoc* group from which they originated; the creative and helpful ideas this group contributed are too numerous to list.

The steering committee selected 15 additional working group members (Table 1) to create a broader and more representative team of individuals and organizations. Collaborative meetings were held approximately monthly from June 4 through November 29, 2007. The committee used several criteria to select a sufficiently diverse group with the necessary background to participate in the collaborative process including: 1) expertise, 2) representation from a variety of organizations, 3) geographic purview (range) and 4) availability.

3.2 Wood Supply Working Group Meetings

The working group met seven times as a full group (see Appendix B for agendas and detailed summaries of each meeting), and held several subcommittee meetings that were organized by our team when an issue of interest arose that could not be sufficiently explored by the larger working group, due to time constraints. Attendance at working group meetings was high, ranging from 14 to 18 participants (Table 2). Meetings were open to the public and rotated between three locations spread across the analysis area. We used a "fish bowl" process at each meeting, in which members of the public were welcome to attend the entire meeting, and could ask questions

or provide comments during a scheduled period. We distributed "Work Books" with background materials to each working group member at the first meeting, which were updated with additional materials throughout the process. Each meeting followed up on working group discussions, requests for additional information and decisions made at previous meetings. The subcommittees developed proposals which they presented to the full working group on the following topics: community protection management areas (CPMAs), "fire-only treatments" where controlled burning might be used in place of mechanical thinning, and treatment scenario attributes. ForestERA transformed detailed subcommittee discussions into spatial data layers that were integrated with the objectives and needs of the broader wood supply analysis process. Topical experts from academia, research institutes, and land management agencies provided additional background information to the group on wildlife issues, treatment impacts on soils, hydrological considerations, conditions favorable to fire-only restoration treatments, and pre-settlement and post-treatment forest conditions.

Meetings were facilitated by Rosemary Romero[6], a professional with extensive experience on a variety of contentious natural resource topics in the southwest including forest biomass utilization. Ms. Romero provided guidance to maximize working group participation and for defining a consensus-based decision making approach, which was refined and agreed upon by the working group. A scribe took notes and prepared summaries of approximately 15 pages in length to record working group discussions at each meeting. We distributed a draft of the summary to all working group members in attendance for review, incorporated many suggested edits, and distributed the final version to approximately 300 stakeholders, as well as posting it on the ForestERA web site (http://www.forestera.nau.edu/).

At the first meeting, held in June of 2007, we provided background and foundational information to the group. Each steering committee member commented on wood supply and utilization issues related to their respective organizations, and described how they hoped this analysis would aid in these issues (for details, see pp. 3-5 of the June 4, 2007 meeting summary in Appendix B). ForestERA summarized the importance of landscape-scale forest restoration assessments and reviewed the main task of developing one or more treatment scenarios that was the focus of the working group. We also provided background information to the group on previous landscape assessments in the analysis area, leaving the question open to them on how

[6] Dexter Albert, Intrinsic, filled in for Rosemary at the last meeting on Nov. 29, 2007.

they would like to use and/or adapt previous products and processes for the wood supply analysis. The USDA Forest Service Director of Forestry and Forest Health for the Southwestern Region described the importance of the study and how the Forest Service intended to use project results. Agency experts provided the group with information on how treatments might be constrained or influenced by regulations and guidelines related to wildlife, soils, and hydrological factors.

At the second meeting, held in July, ForestERA provided detailed information on how other collaborative groups in northern Arizona have built scenarios for previous landscape assessments (Hampton et al, 2006; Sisk et al, 2006). Methods to characterize and strategically place treatments across the landscape were presented to the working group. Building on the presentations by agency experts at the June meeting, ForestERA presented maps depicting technical methods to incorporate treatment guidelines and regulations relevant to siting treatments. For selected landscape conditions (e.g., steep slopes, northern goshawk nest areas) we reviewed data layers and estimates describing how each factor might influence a treatment scenario. The group found this map-based presentation of various options useful and requested that we continue depicting progress in this manner. At the end of this meeting, the working group developed the following "road map" for the process they would like to use to develop their treatment scenario for the purposes of determining potential wood supply:

1. Identify areas appropriate for restoration treatments that recover wood byproducts (i.e., "What's on the map?")
2. Define management objectives (i.e., "target conditions")
3. Select appropriate landscape-level treatment characterizations

The working group also discussed the utility of prioritizing treatment locations to convey their preference of how treatments should be sequenced in time. Some individuals expressed that it is the spatial and temporal heterogeneity of forest structural features that prevent large-scale stochastic changes in wildlife habitat and allow for transitional shifts in wildlife distributions in response to treatments. However, the group decided that there was insufficient time to pursue a prioritization assessment with the current wood supply analysis.

At the third through sixth meetings, held between August and November, the working group defined specific components of their scenario, such as the desired post-treatment forest conditions, following the road map they had developed previously. At the final meeting, on Nov.

29, a proposal to place thinning treatments on approximately 40% of the full analysis area (partitioned within the landscape as 70% within the CPMAs and between 30% and 40% within the remaining management areas, for a total of 41% overall; see details in section 3.4.5) was offered by a minority of participants as the greatest area that they felt would be broadly acceptable for mechanical restoration treatments. This minority preferred other restoration options be used where feasible in the remaining areas, including fire-only treatments, wildland fire use (WFU), non-commercial thinning (or thinning that would not add to wood supply). This precipitated a spirited discussion by the group that included concerns about whether this level of mechanical treatments would achieve the USDA Forest Service Southwestern Region's objective of restoring the functionality of frequent-fire forests. After considerable debate the group accepted this level of thinning as the consensus scenario. However, a majority of participants were adamant that the final report reflect that a large number of working group members felt that mechanical thinning was appropriate on up to 74% of the landscape. We scheduled time at this meeting to discuss potential economic analyses that might be pursued in the future, as a follow-up to this supply analysis, however, the group required this time to finalize their treatment scenarios.

Throughout the process, special topics came up requiring more time than available at the full working group meetings. For example, several working group members identified the need for better information on the parameters that affect the timing, placement, and application of prescribed and/or wildland fire use practices within the wood supply study area. Complex questions about the location and intensity of treatments in areas defined by the wildland-urban interface (WUI) also arose. Subcommittees of working group members worked between full group meetings to study these issues in greater detail and draft spatial data products to assist the working group in their collective decision making concerning these and other topics demanding special consideration.

3.3 Keeping Stakeholders and Elected Officials Informed of Project Progress

We used several modes of communication to update stakeholders of the progress made throughout the wood supply analysis. The most comprehensive were meeting summaries posted on the wood supply analysis web site (http://www.forestera.nau.edu/project_woodsupply.htm). We also developed a Wood Supply stakeholder list with approximately 300 email addresses, drawn from previous ForestERA efforts, that was updated with recommendations from working

group members, Forest Service public affairs officers and requests from individuals. Stakeholders received agendas prior to each meeting inviting them to attend as observers, and they were sent summaries following each meeting. A time was reserved at the end of each meeting for observers to ask questions or provide comments. We also announced in each email and on our web site how to provide comments via voice mail, email or U.S. post. Comments and questions provided were addressed at subsequent meetings.

Based on advice from the working group, we selected meeting locations distributed throughout the analysis area to encourage public attendance. We also prepared a one-page handout and distributed these at our first meetings, to assist working group members as they informed their colleagues and constituents who were not part of the working group. At the request of an observer at our first working group meeting on June 4, we expanded the wood supply analysis web site to include the contents of the Wood Supply Work Book that had been provided to working group members. To keep elected officials and other key players in the region informed of project developments, the steering committee developed a list of contacts to whom they provided periodic updates on project progress and products.

3.4 Working Group Treatment Scenario

One of the main goals of the wood supply analysis, and the primary task of the working group, was to build agreement on the location and type of ecologically appropriate treatments across the analysis area to improve forest health. This map-based product is referred to in this analysis as a "treatment scenario." The overall objectives of the group's scenario were, first, to restore fire-adapted (ponderosa-pine) ecosystems and protect communities from destructive fires, while mitigating adverse impacts of treatments on soils, surface water and wildlife. Secondly, based on restoration needs, the scenario defines the intensity and location of potential mechanical thinning treatments used to estimate the supply of wood byproducts. To accomplish these objectives, the group divided the landscape into areas where restoration byproducts were not available from mechanical tree thinning and those that were a potential source. They further divided the potential source areas into the five landscape management areas for which they developed various management objectives and desired post-treatment conditions, based on the "informed judgment" of experienced restoration practitioners from land management agencies and other organizations within the group (Table 3; Figure 2). Working group meeting summaries (Appendix B) contain detailed discussions on the development of treatment scenarios.

3.4.1 Landscape Features Considered Not a Source of Wood Supply

The working group agreed that areas associated with seven landscape features were not considered a source of wood supply, ranging from slopes too steep for most mechanical harvesting equipment, to various soil, hydrological and wildlife habitat conditions (Tables 3 and 4). However, the group agreed that MSO protected activity centers (PACs) and other sensitive species habitats might be thinned lightly from below in some cases. The seven landscape features covered 26% of the 2.4 million acres of ponderosa pine-dominated lands in the analysis area (shown in black in Figure 2), leaving 1.8 million acres available as potential supply (Table 5). In addition, even though no changes were made numerically to the acres or volumes in either scenario based on road access, the group wanted to express that they had low confidence that areas further from ¼ mile from existing roads (constituting an additional 241,000 acres outside of the seven landscape features not considered a source of wood supply) would be a source of restoration byproducts in the near-term, due to limits of harvesting technologies in common use in the region, and to concerns over environmental impacts associated with both the road improvements necessary for harvesting and new road construction. An increase in the use of forwarders was looked on favorably by the working group to extend the yarding distance from ¼ to ½ mile from roads. A USDA Forest Service transportation engineer informed the group that many current roads were not adequate for transportation of wood in large trucks. Many of the areas with roads may not be available for wood supply or would need improvements. It was impossible to quantify the net impacts of these various access issues, given existing roads data.

On a separate issue, the group decided not to discuss or identify wood supply associated with severely burned areas. Salvage logging is controversial, and the group recognized that revisiting this debate could detract from the goal of the study to find common ground.

MSO PACs are 600 acre areas within which owls have been found to be nesting. Trees < 9" dbh may be removed in these areas, but it is minimal, so the working group decided not to include these areas as potential wood supply for the purposes of this study. Specially Designated Areas found in the analysis area include Wilderness Areas, National Game Preserves, Research Natural Areas, Primitive Areas and Inventoried Roadless Areas. For our analysis, a northern goshawk nest area was defined as a 180-acre circular area (i.e., total area was computed as six nests areas each encompassing 30 acres) geometrically centered on an individual goshawk post-fledgling area (PFA). These 180-acre areas were not considered a source of wood supply. Six

unique goshawk nest locations, for which PFA data were not available, were also buffered at an extent that totaled 180 acres. Soils with mechanical treatment limitations due to factors such as erodibility and rocky conditions were identified by USDA National Forest soil scientists. Areas with soil conditions that could be mitigated using best management practices (BMPs) were not included in this landscape feature. The working group considered the various management practices of the four National Forests and other lands in the analysis area in terms of restricting treatments directly adjacent to streams in order to maintain and protect these "filter strips" from potentially negative impacts of mechanical treatments. We determined from contacting Forest Service hydrologists and other staff that the Apache-Sitgreaves is the only National Forest in the analysis area that precludes mechanical treatments from areas next to streams. The other National Forests specify BMPs to mitigate damage, but have no rules that specifically restrict equipment from these areas. In order to maintain consistency across the landscape, the working group decided not to consider areas as a source of wood supply that are within 100 feet of perennial streams throughout the analysis area, and on both perennial and intermittent streams in the Apache-Sitgreaves National Forests due to the availability of data on intermittent streams.

The "treated areas" landscape feature includes areas the USDA Forest Service identified as having moderate to high intensity thinning treatments completed or contracted in the last 10 years,[7] including 30,000 acres as part of the White Mountain Stewardship Project (WMSP) contract. These areas warrant special attention due to data limitations and because they do not include the majority of areas contracted to the WMSP. The USDA Forest Service estimates that there are upwards of 120,000 acres remaining in the WMSP contract, however specific locations for these thinning treatments have not been defined, so could not be included in the "treated areas" landscape feature. This is important to consider in developing new stewardship contracts as the wood volume estimates provided in this analysis include byproducts from remaining WMSP restoration treatments.

Incomplete treatment information, in combination with disturbance-related mortality (e.g., wildfire, insect outbreaks, drought) over the past 10 years lead to our decision to develop updated forest structural information based on 2006 Landsat imagery. The compilation of data on previous forest treatments in the wood supply analysis area required contacting and visiting

[7] As this study focused on year 2006 conditions, working group members did not discuss or indicate preferences for the type or intensity of future restoration treatments within areas thinned in the past ten years.

an interdisciplinary team of GIS, timber, fuels, managers, and silvicultural staff at the four National Forests.[8] During the course of this analysis, the National Forests in the study area were in transition between two databases, Rocky Mountain Resource and Information System (RMRIS) and Forest Activity Tracking System (FACTS). This transition complicated data access and, in some cases, rendered the most current data unavailable. Also, spatial data often resides in multiple locations, such as individual district offices, and the attribute or tabular data resides elsewhere (databases or individual digital or hard copy documents) requiring more than one person with knowledge of the data and the correct expertise to access, query, or compile the various data sources. In addition to the incomplete nature of this data layer across the study area, the standards for tracking forest treatment data have changed over time.

3.4.2 Landscape Management Areas

Among the five landscape management areas that were considered a potential source of wood supply, the community protection management areas (CPMAs) received the highest ranking for tree thinning from the working group. The group's ranking meant that management objectives for CPMA's took precedence wherever they overlapped another management area (see rank of each management area in column 1 of Table 3). Although, the working group ranked the management areas for purposes of reconciling spatial overlap and defined procedures resulting in varying areal extents for each, they did not prioritize them in terms of a preferred sequencing over time for restoration. The MSO restricted habitat management area (rank 2) is defined by areas with pine-oak vegetation and used in tandem with the group's basal area management objectives is designed to follow MSO Recovery Plan guidelines for other restricted habitat and target/threshold conditions at the semi-regional scale. The municipal watersheds management area (rank 3) contains 6th level watersheds with surface water supplies for communities.[9] The

[8] We either met in person or otherwise contacted the following Forest Service employees from the Kaibab NF: Jerry Drury**,** Bob Richardson**,** Bruce Higgins (contractor and former FS employee), Mark Herron, Tim McGann, Dave Mills, Woody Rokala; from the ASNF: Susan N Lee**,** Gayle Richardson, Monica Boehning**,** Joseph A Hamrick, Laura A Mounce, William H Ripley, Georgia Morris, Margaret Kirkeminde, Nancy Loving, Pamela Klein-Taylor, Stacey L Weaver, Steven Richardson, Dan Mindar, James Pitts, Robert S Taylor, Kerry Nedrow**,** Raymond Rugg, Deryl Jevons**,** Elaine Zieroth, Patti O'Connor**,** Margaret Kirkeminde; from the Coconino NF: Pat Key, Mike Manthei, Frank Thomas **,** Kim Newbauer**,** Jeffrey Thumm**,** Joe Luttman**,** Carl Beyerhelm**,** Andy Stevenson**,** Patty Ringle**;** and from the Tonto NF: David Bailey, Carolyn Williams, Don Nunnelly and Pam Rule. In addition on fire and vegetation mapping issues, we contacted: from the Missoula Fire Lab: Laurie Kurth, Chuck McHugh, and Rob Seli; from Region 3: Gilbert Zepeda, Linda Wadleigh, Wayne Robbie, Jack Triepke, Tom Mellin, Jeff Hogg, Georgie Porter, and Bill Krausmann; and from FIA Ogden, UT: Michael Wilson, Ron Tymcio and John Shaw.

[9] Municipal watersheds are also referred to as community "source water supply" by the USDA Forest Service.

working group defined the aquatic species watersheds management area (rank 4) as 6th level watersheds in which native fish are known to occur. The wildlands management area (rank 5), which was a catch-all for areas not defined by the other four, covered the largest area at 788,000 acres, or 33% of the 2.4 million acre ponderosa pine-dominated analysis area (Table 5).

3.4.2.1 Community Protection Management Areas

A working group subcommittee developed several options for defining the CPMAs, which they presented to the full group. A total of six Community Wildfire Protection Plans (CWPPs; Tusayan, Flagstaff, Williams, Rim Country, Apache and Sitgreaves), encouraged by the Healthy Forests Restoration Act of 2003, have been developed and approved by local governments in the wood supply study area. In evaluating WUI zones defined in the CWPPs to develop proposed treatments for the wood supply analysis, it became apparent that not all CWPPs were developed in the same manner, and this variability precluded consistent application of analytical techniques across the analysis area. For example, some plans identified high priority treatment areas as subsets within their community's CWPP boundary, while other plans assigned high priority to the entire area contained within their CWPP boundary. The working group struggled to incorporate and honor the boundaries and recommendations established in the various community-sponsored CWPPs in the analysis, but decided for consistency to apply the same treatment scenario approach within all CWPP analysis areas as was applied through the study area. This should not be construed as an attempt by the working group to reestablish the boundaries designated by communities, but rather as necessary in order to create consistency across the analysis area. Specifically, the full group decided to define CPMAs by assigning a ¼-mile protection buffer around all private lands, with an additional ½-mile protection buffer, extending to 1½-mile in the upwind direction, of all private property within "high priority" areas identified in CWPPs. This resulted in a CPMA, aggregated across the study area, that is approximately 600,000 acres smaller than the area identified in the various CWPP's, and proposed treatments that differ slightly from some CWPPs. The wood supply volumes derived could be adjusted, if adequate information on volumes generated by specific CWPP recommended treatment scenarios is developed through alternate techniques, however, only four of the six CWPPs defined recommended treatments. Therefore, the working group agreed that current estimates be developed from consistent application of the same techniques throughout the study area while presenting the treatment information available in completed CWPPs (Figure 3).

3.4.3 Desired Post-Treatment Conditions

For each landscape management area, the working group specified a post-treatment basal area distribution appropriate for the area's management objectives (see column 2, Table 3) and designed to generate heterogeneous forest structural conditions at the landscape scale (Figure 4). Basal area distributions were derived through informed judgment and group negotiation. The group endeavored to balance key land management issues that included: 1) the desire to reduce the threat of catastrophic fire; 2) concerns about aggressive or intensive thinning in wildland areas; 3) the need to both protect wildlife habitat from unnaturally-severe fire while simultaneously proceeding with caution to minimize any potential negative impacts of treatments on wildlife and their habitats; and 4) a desire to maintain landscape heterogeneity. Scenario and wood supply outcomes reflect this balancing act. For example, the proposed thinning for the CPMAs is more aggressive than the thinning goals in wildland areas, while desired post-treatment distributions in MSO restricted habitat allow for 10% of the forest to have a basal area > 150 ft^2/acre to promote MSO target/threshold habitat. These are not precise determinations or prescriptions; rather, they are assumptions that allow for the estimation of wood supply, as requested in this semi-regional scale analysis.

From the total basal area layer (described below and shown in Figure 5), a scenario algorithm was used to fit the existing distribution for each landscape management area to a desired post-treatment condition, while maintaining the original order of low to high basal area conditions (Figure 4). In other words, lower pre-treatment basal areas were "matched" to lower post-treatment basal areas and higher initial values were matched to higher post-treatment values according to the shape of each curve. The pre-treatment basal area was shifted downward (Appendix C) unless it was below a minimum desired condition (e.g., < 40 ft^2/acre in wildlands) in which case the values were left unchanged. The dominant thinning level ranged from heavy in the CPMAs to light in MSO Restricted Habitat (Tables 6 and 7) and match the guidelines for these levels developed by the group (column 4, Table 3). The modeled treatments in the management areas, especially the high intensity treatments in the CPMAs, interspersed with the untreated areas removed from consideration as a source of wood supply, create a heterogeneous pattern of potential post-treatment basal areas across the landscape (Figure 6).

3.4.3.1 Wildlife Considerations in Developing Desired Post-Treatment Conditions

Ponderosa pine forests in northern Arizona are naturally heterogeneous in structure (Covington and Moore 1994, Allen et al. 2002, Appendix D: table supplied by ERI to working group on pre-settlement conditions in Woolsey plots and other sites), and provide habitat for a diversity of wildlife species. Although the effects of thinning and burning on forest over- and understory vegetation are fairly well understood, we do not completely understand how changes in forest structure and function impact, modify, and/or change habitat for individual wildlife species, their population dynamics, or community organization (Governor's Forest Health Councils, 2007, p.19). It is likely that the spatial arrangement of retained trees following forest restoration treatments plays an important role in determining habitat value at the landscape scale. Wildlife are ecologically and socially important components of the forest ecosystem, and management interventions should be designed to provide the diversity of habitats needed to support and sustain wildlife populations (as recommended by Chambers and Germaine, 2003). Therefore, the working group recommends implementation of a variety of thinning and/or burning treatments juxtaposed across the landscape, including areas with untreated forest. The timing of treatments should also vary across the landscape to allow for transitional shifts in wildlife distribution in response to treatments.

The broad target range of basal area and the distribution of different treatments included in the working group's scenario (Figure 4), interspersed with areas having no mechanical thinning treatments, afford a variety of future potential conditions for wildlife. Beier and Maschinski (2003) point out that our current knowledge of pre-settlement conditions is likely incomplete as it does not fully account for portions of the landscape that had dense stands with large snags, prior to EuroAmerican settlement. They also note that Threatened, Endangered, and Sensitive (TES) species may specialize in habitats "atypical" of those described by current pre-settlement reconstructions. They recommend that we increase our understanding of the spatial heterogeneity of pre-settlement conditions, while noting that, given the relatively small areas occupied by TES species, their consideration will likely not seriously constrain restoration efforts (see also Prather et al., 2007, for a closer look at the MSO). In addition, Beier and Maschinski (2003) reason that ecosystem changes in the last century (climate change, loss of top carnivores, the spread of invasive species, anthropogenic edge effects and fragmentation) may preclude full restoration of structure and function, and "ecosystems may as a result take

unexpected trajectories after restoration treatments, justifying a cautious approach." The working group targets for basal area distributions outside of CPMAs include some areas of higher tree densities to provide a variety of habitat conditions for TES and other wildlife species, such as tassel-eared squirrels.

3.4.4 Review of Recently Planned and Completed Restoration Projects

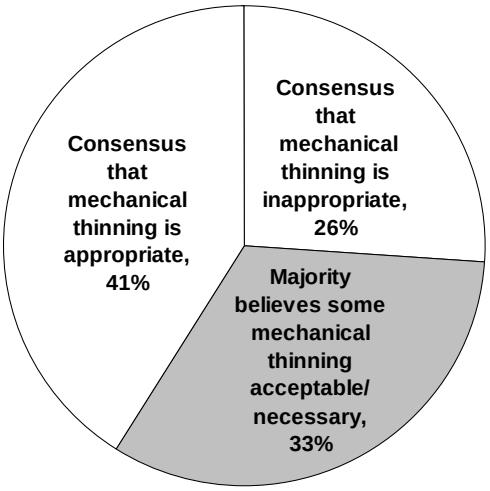
The amount of ponderosa pine (PP) that is thinned mechanically in recently planned and completed restoration projects in the analysis area is influenced by both biophysical and institutional constraints. These include the presence of archeological and historical sites, steep slopes, wildlife habitat concerns, access on suitable roads, streamside management zones, erodible soils, and administrative removals (e.g., Research Natural Areas). The effect of these factors on areas thinned shift over time to varying degrees given forest growth, vegetation disturbances and other changes. This study is focused on year 2006 conditions. The consensus and majority scenarios identified 26% of the study area as being inappropriate as a source of wood byproducts from restoration thinning treatments, based on spatial analysis using available map-based data. Since it was not possible to include all factors known to affect treatment placement at the landscape scale due to data limitations, it is reasonable to expect that a higher percentage of the total area would not be thinned. To explore this hypothesis we reviewed a sample of current treatment projects and interviewed Forest Service personnel.

We reviewed eight National Environmental Policy Act (NEPA) approved restoration projects on the Coconino and Apache-Sitgreaves National Forests as described in the Environmental Assessments (EAs). All projects had successfully gone through the NEPA process and all special considerations (e.g., riparian areas, slope, MSO PACs) were included within the original NEPA planning area. In combination with 19 additional EAs analyzed by the Grand Canyon Trust, an average of 37% of project areas were found not to have been thinned (Table 8; see Appendix E for more details). A similar review by a Timber Staff Officer on the Kaibab National Forest (NF) of recently sold and closed timber sales, all NEPA approved, found 38% of the project areas were not thinned (personal communication with Jerry Drury, 2007) and Forest Service personnel on the Apache-Sitgreaves NF estimated that perhaps 40-50% were not thinned (personal communication with Elaine Zieroth, 2007). These figures indicate a value in the high 30s up to mid- 40s may be a reasonable estimate of the average percent of acres within a NEPA planning area which would not receive mechanical treatment. However, a larger sample

size distributed throughout the study area would be required to provide a range with greater certainty.

3.4.5 Range of Agreement

The group reached consensus that 26% of the 2.4 million acre analysis area should not be considered a source of wood supply for various reasons (see section 3.4.1) and that 41% should be considered a potential source of material generated by mechanical harvesting as part of the restoration or fuel reduction treatment. In addition, a majority of working group members believed that some portion of the remaining 33% of the landscape (up to a total of 74%) should be considered for mechanical thinning. The following pie chart represents the level of agreement among stakeholders as a percentage of the entire analysis area:



In the above pie chart, areas in white represent consensus over a total of 67% of the landscape. Areas in gray represent the remaining 33% of the landscape where there is a lack of consensus, but the majority of working group members believed that some mechanical thinning would be acceptable and/or necessary.

Although there was consensus among working group members that 26% of the analysis area was not a potential source of wood supply, as described in section 3.4.1, this value is less than the average value we observed from a sample of actual projects (37%) and estimated by Forest Service staff (high 30s to mid 40s). It was reasoned that the value derived via spatial analysis (26%) is an underestimate because site-scale factors known to limit the extent of treatments were not accounted for by this semi-regional scale analysis, such as archeological sites, historical sites, wildlife movement corridors, and areas with insufficient road access, that

were stated in EAs as reasons for limiting the amount of area thinned. It was not possible to adequately determine the magnitude of these factors without more detailed study of the EAs and more detailed map-based data. The reason that the majority finds mechanical thinning acceptable on some, and not all, of the remaining 33% of the landscape is due both to the unknown influence of factors that affect the total amount of area treated, but also the fact that the group ran out of time to more thoroughly discuss this topic. Therefore the group did not decide under what conditions these additional acres might be considered appropriate for mechanical treatment yielding wood supply.

Working group members who recommended the consensus scenario maintain that if mechanical treatments were placed strategically across the 41% of the landscape identified in the consensus scenario, unnatural fire behavior might be significantly curtailed at the landscape level. They envision that the remaining areas could be left open for additional restoration treatment options, such as wildland fire use, prescribed fire-only treatments, and non-commercial thinning. The strategic aspect of this approach is recommended in the Statewide Strategy for Restoring Arizona's Forests (Governor's Forest Health Councils, 2007): "Federal and state land management agencies should collaboratively and strategically place treatments in order to increase efficiency and maximize benefits." However, others hold the view that thinning provides more "control" in terms of determining which trees will remain and reducing fire threat.

The working group partitioned the area to be restored using mechanized thinning for the consensus and majority scenarios into to the following proportions of each landscape management area:

Landscape management area	Consensus (% / acres)	Majority (% / acres)
Community protection	70% / 316,000	74% / 335,000
MSO restricted habitat	30% / 114,000	74% / 237,000
Municipal watersheds	40% / 35,000	74% / 60,000
Aquatic species watersheds	35% / 184,000	74% / 334,000
Wildlands	35% / 339,000	74% / 788,000
FULL ANALYSIS AREA TOTALS:	41%[10] / 988,000	74% / 1,775,000

These proportional breakdowns for the consensus scenario were based on informed judgment, without mention of specific, area-by-area rationale during the collaborative meetings,[11] whereas the 74% for the majority scenario was based simply on the portion of the analysis area remaining after areas deemed not a source of wood supply in the consensus scenario (Table 4) were removed from consideration. Note that the 74% figures for each management area in the majority scenario are only approximations, as some of these areas already meet desired post-treatment conditions, and each management area had different proportions of steep slopes and other factors contributing to the 26% of areas across the full landscape considered not to be a source of wood supply.

4 Estimating Wood Volume and Supply

4.1 Methods

4.1.1 Developing Forest Structure and Wood Volume Layers

Data to perform the wood supply analysis were developed using modern statistical tools and remotely-sensed data outlined in the following section. Principle data layers developed were for

[10] The proportional breakdowns for each landscape management area resulted in a total of 41% of the overall landscape dedicated to mechanical thinning treatments in the consensus scenario.

[11] As part of comments received during working group review of a draft version of this final report, the following rationale was put forth by the minority who proposed the proportional breakdown. The proportional breakdown is part of a three-tiered comprehensive landscape restoration strategy in which: 1) intensive mechanical thinning treatments are placed across 70% of the CPMA, 2) additional mechanical thinning treatments are placed strategically to significantly reduce uncharacteristic fire behavior across 30-40% of each of the remaining landscape management areas (informed in part by the work of Mark Finney at the USDA Forest Service Missoula Fire Sciences Lab, e.g., Finney 2006 and Finney et al. 2007), and 3) other restoration options are used where feasible and needed in the remaining areas, including prescribed burn-only treatments, wildland fire use (WFU) and non-commercial thinning (or thinning that would not add to wood supply). In addition, this approach provided a surrogate for explicit fire treatments and other thinning treatments that wouldn't result in wood supply during the process (see Section 6.4). The individual components of this strategy were discussed during the collaborative process, however, they were not presented to the group as a cohesive strategy.

total wood volume and basal area per acre. Additional layers for basal area and wood volume were developed for trees <5", 5 to16" and >16" dbh. Three broad diameter classes were selected by the working group as an appropriate range for estimating wood volume at the scale of the analysis area with available data. Tree density and percent canopy cover were additional forest structural layers derived for the wood supply analysis area. A total of 10 principal data layers developed are listed as follows:

- Volume
  - Total wood volume (ft^3/ac)[12] (Figure 7)
  - Wood volume (ft^3/ac) for classes <5", 5-16" and >16" dbh (Figures 8-10)
- Forest structural parameters
  - Tree density (trees per acre)
  - Canopy cover (%)
  - Total basal area (ft^2/ac) (Figure 5)
  - Basal area (ft^2/ac) for classes <5", 5 to16" and >16" dbh

A total cubic foot volume layer was used for comparison with three diameter class layers to assess potential computation errors within each category. We developed basal area layers by diameter class to estimate whether the amount of wood byproducts[13] resulting from restoration treatments could meet post-treatment objectives by harvesting small-diameter trees (<16" dbh) further discussed below. Three primary data sources were integrated for mapping forest structure and volume across the study area to estimate wood supply, 1) USDA Forest Service Forest Inventory and Analysis (FIA) permanent plots for the ponderosa pine type established from years 1995 to 2005, 2) twelve Landsat 5 Thematic Mapper (TM) scenes from "leaf-on" (September 2006) and "leaf-off" (October 2006) image dates and 3) a 30m digital elevation model (DEM). We resampled all digital data to a 90m pixel resolution to adjust for potential spatial displacement between FIA plots and grid cells.

We used FIA plots and coordinates to create a ground reference dataset of forest structural attributes from plot locations with no evidence of disturbance (e.g., fire, tree harvest, insect attack, etc.) prior to Landsat image dates. Plots were selected using a change detection

[12] Cubic foot volume includes all portions of the tree bole or main stem **without** deductions for top and stump material above or below a diameter limit. Crown material such as limbs, foliage and bark are not included for this estimate.

[13] Byproducts are defined as all woody material removed from a site as a result of forest restoration treatments.

analysis and the Normalized Vegetation Difference Index (NDVI) derived from Landsat image years 1999, 2004 and 2006. NDVI is calculated as Landsat (*Band 4 – Band 3)/(Band 4 + Band 3)*, which is sensitive to changes in plant biomass (Jensen 2000). Plots showing no negative departure in NDVI values over time in the ponderosa pine type were retained for the reference dataset (n = 420).

Forest structural variables and wood volume for each plot were then estimated for year 2006 using the Central Rockies Forest Vegetation Simulator (FVS) growth model to match image dates. FVS was used to project FIA plots and forest structural variables up to 2006 using growth simulations. To implement growth simulations compatible with FVS assumptions, site indices taken from FIA plots and tree cores were first converted from a base age of 50 to 100 years using equations obtained from the USDA Forest Service-FVS support group at the Forest Management Service Center in Fort Collins, Colorado. No tree regeneration was added to simulations as short growth cycles were used ranging from 1 to approximately 11 years depending on the plot establishment date.

Wood volume was calculated from the ground reference dataset (FIA plots) in FVS using total cubic feet for the ponderosa pine type in the study area with equations by Hann and Bare (1978) for southwestern tree species. A total volume measurement for tree boles was chosen for this scale of analysis and technical constraints as they apply to the ground data and the remote sensing applications used. Wood volume and biomass estimates, further discussed below, were derived from images acquired by the Landsat TM satellite sensor that observes forest canopy from overhead. Deductions or separate quantifications for portions of the stem such as tree tops and stumps above and below a diameter limit were not feasible at the spatial and spectral resolution of TM data. Nevertheless, tree tops and other parts of the tree are also potentially utilized with increased market demand for these materials (Rummer et al. 2005). Other methods were employed to determine restoration byproducts from tree crown material (limbs, bark and foliage) outlined in section 4.1.2.2. Thus, estimates for crown weight in addition to wood supply from tree boles were derived separately.

From leaf-on and leaf-off Landsat imagery, we derived 34 spectral variables (e.g., TM bands 1-5, 7, corrected NDVI (NDVIc), wetness, greenness, brightness, etc.) potentially related to forest structure and ponderosa pine wood volume. NDVIc applies a middle infrared correction to NDVI (Nemani et al. 1993) that has been shown to be a better predictor of leaf area index and

sensitive to differences in coniferous forest biomass (Pocewicz et al. 2004). Terrain corrected images from the USGS Earth Resources Observation and Science Data Center were used to assure minimal registration error. Landsat bands were converted to top of atmosphere (TOA) reflectance from image calibration data following (Chander and Markham 2003). Additional predictor variables related to the biophysical environment; elevation, surface roughness, slope and cosine transformed aspect, were derived from the DEM.

To estimate forest structural parameters and wood volume across the study area via digital data layers, we used *k*-nearest neighbors (*k*-nn) imputation statistics. Summary forest structural variables from the reference dataset were predicted using spectral variables associated with each plot, and then used to interpolate values across the entire study area. Each data layer was evaluated for accuracy (Table 9) using a "second nearest neighbors approach" that compares forest structure values from FIA reference plots to imputed values (also see Ohman and Gregory 2002). To implement this approach, the "yaImpute" package (Crookston and Finley 2007) in R statistical software v. 2.5.1 (R Foundation for Statistical Computing 2007) was used. Ohmann and Gregory (2002) provide a recent example of *k*-nn methods that were enhanced for the wood supply analysis using the Random Forest decision tree algorithm (Breiman 2001). Comparisons between Random Forest and other modeling techniques have demonstrated superior performance, flexibility and accuracy (Gislason et al. 2006, Culter et al. 2007). Modifications to Random Forest for *k*-nn imputation and deriving forest structural variables are further discussed in Crookston and Finley (2007).

Data layers developed using the above methods considers forest conditions for the 2006 Landsat imagery and FIA reference dataset. Volume accumulation for the ponderosa pine type in northern Arizona averages ~40 ft^3/ac/yr (see section 6.4) that contribute additional wood volume and supply over time. The present analysis limits wood supply predictions to volume levels determined from the 2006 dataset only (Table 10). Further analysis is warranted to include assumptions about annual treatment and growth rates to estimate forest growth and additions to wood supply over a specified planning period.

4.1.2 Estimating Amount of Wood Byproducts from Restoration Treatments

4.1.2.1 Wood supply volume

Forest restoration treatment scenarios for each landscape management area (Figure 2) were applied as reductions in existing total basal area by the wood supply working group. Restoration

objectives for the ponderosa pine type and desired post-treatment conditions developed by the working group are outlined for each of five landscape management areas in Table 3. The group wished to limit their assumptions on how restoration treatments might be applied at a local-scale and no guidance is being given with this report for designing site-level silvicultural treatments.

Assumptions for implementing restoration scenarios were functionally applied to accommodate data layers and analyses developed at a semi-regional scale. Manipulation of stand tree lists and size-class distributions were not feasible at this scale. A desired distribution or range of post-treatment conditions is based on total basal area (Figure 4). Therefore, post-treatment basal area and the amount removed from treatments was the variable of interest used to guide scenarios and generate wood supply estimates (Figures 5 and 6). Moreover, it was acknowledged that treatments should focus on removing small-diameter trees as the central objective of the wood supply analysis, but no diameter limitation was placed on restoration scenarios or supply calculations.

To obtain wood volume harvested as a byproduct of treatments, a non-linear regression model was used to determine cubic foot volume from the amount of basal area removed. To establish these relationships, we used basal area and total wood volume from FIA plots in the reference dataset (n = 420). All values were log transformed to meet variance and normality assumptions. A final model showed a good fit to the data ($r^2 = 0.81$, $p < 0.0001$) resulting in the following equation:

Eq. 1 f = y0 + a*x

where, f = cubic foot volume, y0 = 0.9770, a = 1.118 and x = log(basal area). Results from the regression model demonstrate a strong relationship between total basal area and total cubic foot volume in the ponderosa pine forest type for this landscape.

From the total basal area layer, a scenario algorithm was used to fit the existing basal area distribution for each management area to post-treatment conditions (Figure 4). Locations within a management area that were already at or below a minimum basal area specified in Table 3 were left untreated and did not contribute to wood supply. Locations with a basal area above the minimum value were assumed treated (i.e., thinned) and used to determine wood supply with regression Equation 1. Thus, the total amount of basal area removed from each grid cell was the principle explanatory variable used for wood supply calculations. A range in wood supply volumes were estimated for each management area, integrating working group scenarios from a

consensus level (100% agreement) to a level where the majority of the participants were in agreement (Table 11). In the consensus scenario, locations with the highest basal area within the specified fraction of each landscape management area (see section 3.4.5) were assumed to be treated (41% of landscape). These areas were also included in the majority scenario as well as remaining lands deemed appropriate for thinning (74% of landscape). Pre- and post-treatment landscape conditions (basal area) for the majority scenario are shown in Figures 5 and 6.

4.1.2.2 Wood supply biomass

The working group wished to augment cubic foot volume estimates of potential wood supply from tree boles with forest biomass in terms of weight (i.e., tonnage). For this report on wood supply, biomass was defined as the weight of all above ground material generated as a result of the consensus or majority restoration scenarios. Tree bole and crown weights are useful measurements when all parts of the tree are potentially utilized or disposal costs of non-merchantable portions of the tree are important (Rummer et al. 2005). Biomass estimates for this analysis were calculated in green tons that include all above ground portions of the tree partitioned into tree boles and crown material. Biomass was calculated by using a simple factor to convert from cubic foot volume[14] to green tons for tree boles generated as wood byproducts from each restoration scenario. Therefore, calculations for crown weights were in addition to wood supply estimates for tree boles. Crown biomass estimates included material from foliage or needles, bark and limbs that were calculated by developing a relationship between tree bole and crown weights with the following procedures:

1. FIA plots from 1995 to 1997 (n = 482) in the ponderosa pine type were used to develop a relationship between tree bole and crown weight from regression estimation. For each plot, tree bole and crown weights were calculated using the tree biomass function in FVS ("Treebio" FVS event monitor function)[15].
2. Total cubic foot wood supply estimates from tree boles for each restoration scenario (i.e., consensus and majority) were converted to green tons using a factor of 0.0315 (0.0315

[14] Cubic foot volume and tree bole weights from the wood supply estimate include all material from entire length of the main tree stem. Bole weight supply estimates are equivalent to cubic foot volume estimates and are the result of a unit conversion.

[15] FVS equations for tree boles and crown weights are from the USDA Forest Service Wood Products Laboratory (1999) and Brown and Johnston (1976) respectively.

green tons = MCF)[16]. This was a simple unit conversion and does not contribute additional wood supply above that from tree bole volume estimates derived for each restoration scenario.

3. To estimate crown biomass that is in addition to wood supply from tree boles, a relationship between bole and crown weights from FIA plots was developed via non-linear regression. Values for stem and crown weight were square root transformed to meet normality and variance assumptions. The regression resulted in an $r^2 = 0.69$ ($F = 1078$, $p < 0.0001$) and equation:

   Eq. 2 f = y0 + a*x

   where, f = crown weight (green tons), y0 = 0.5997, a = 0.5432 and x = sqrt(stem biomass). Stem weight was generally three times greater than biomass comprising crown material.
4. Data were summarized by total and average per acre bole and crown biomass for treatments in each landscape management area (Table 12). We compared green tons to USDA Forest Service timber cruise estimates from White Mountain Stewardship Project (WMSP) contracts (n = 31) on the Apache-Sitgreaves National Forest from years 2004 to 2007. WMSP contracts are referred to as "stewardship contracts" for discussing results below.
5. Biomass estimates are also presented in oven dry tons for tree boles and crown material (Appendix F).

4.1.2.3 Wood supply from small-diameter trees

The working group also wished to examine the amount of land area and volume where thinning could meet post-treatment conditions by harvesting only small-diameter trees (i.e., trees <16" dbh). For the purposes of this report, the group selected a 16" dbh threshold due to its common use within the analysis area as a break differentiating "small" and "large" diameter trees in the ponderosa pine forest type. Although wood supply estimates include trees >16" dbh to meet post-treatment conditions, the focus of this study was on small-diameter trees. There was no concurrence within the working group that trees >16" dbh should be cut and removed outside of CPMAs.

[16] A wood volume to biomass conversion factors were obtained from "Monitoring and Measuring Wood Carbon" by Sampson (http://www.sampsongroup.com/Papers/papersdocuments.htm).

To perform this analysis, we estimated the extent and location of areas where post-treatment basal area conditions were met by cutting only trees <16" dbh and locations where cutting trees >16" dbh would be necessary to match basal area distributions in Figure 4. A rule set developed by the working group for identifying these locations follows that 10% and 20% of the basal area per acre must be retained after thinning from trees <5" dbh and 5 to 16" dbh respectively to allow for uneven-age or heterogeneous forest structural conditions[17]. Principle data layers for existing basal area from trees <5" dbh and trees 5 to 16" dbh were used, subtracting them from the amount of basal area harvested from a location (grid cell). A minimum of 10 and 20% of the basal area was assumed un-harvested for each diameter class and pixel. This has the computational form of:

Eq. 3 Basal area removed – (BA <5" dbh * 0.9 + BA 5 to 16" dbh *0.8)

Pixels with negative values represent areas with sufficient basal area for trees <16" dbh to meet post-treatment basal area conditions. Positive values indentified the amount of basal area that would be necessary to harvest from larger trees (>16" dbh) to meet these conditions. Regression Equation 1 was used to estimate the amount of cubic foot volume potentially derived from small and large diameter trees (i.e., trees <16" dbh and >16" dbh) with the majority restoration scenario only. The number of acres and wood supply volume in each post-treatment condition was then summarized by management area and included with results (Table 13).

4.2 Results

4.2.1 Forest Structure and Wood Volume Layer Accuracy

We derived volume and forest structural layers from TM imagery representing conditions up to the fall of 2006. FIA plots were used to validate imputed forest structure and volume layers. The *impute* function of the yaImpute R package provides a practical method to determine layer accuracy by estimating the value of a reference plot (e.g., basal area, cubic foot volume, canopy cover, etc.) from other references in the dataset. Reference data were compared to imputed values via coefficients of determination (r^2) from a linear regression with the intercept set to one. An analysis of residual errors between observed and predicted values (i.e., |observed – predicted values|) was used to estimate accuracy for 50% of the predicted values and then 80% of the

[17] For this analysis, no formal assumptions were made about post-treatment tree size class distributions. However, the working group wished to retain trees <5" dbh (10% of existing basal area) and 5-16" dbh (20% of existing basal area) to allow for spatially heterogeneous forest conditions with a diversity of tree age and size classes.

predicted values (Table 10). For example, the average difference between observed and imputed basal area values is ±5 ft^2 for 50% of the data (Table 9).

Structural layers for total basal area and tree density showed the highest r^2 values (0.77 and 0.74). Imputed values for all structural layers had accuracies which were considered adequate to assess forest conditions at the scale of the wood supply analysis area. Results for the total wood volume estimate showed the highest r^2 value (0.87) overall and low residual error relative to average volume (Table 9). Volume within diameter categories (Figures 8 - 10) showed lower accuracy with available data inputs (Table 9). Nevertheless, total cubic foot volume imputed for the ponderosa pine forest type was quite similar to volume summed over the three diameter classes at 4,561 million ft^3 vs. 4,526 million ft^3 respectively (Table 10). Volume summed for two diameter categories, above and below 16" dbh, was nearly equal to the total volume layer estimate at 4,559 million ft^3. These comparisons identify the <5" dbh class as the greatest source of error among the cubic foot wood volume layers.

Overall, methods used to produce digital data layers showed better than expected accuracy levels. Forest structural data layers showed similar or improved accuracies compared with structural estimates by Ohman and Gregory (2002) who used similar methods and data. Volume estimates within diameter categories were lower than the actual volume in locations with high biomass or canopy cover. Scatter plots for observed and imputed values within diameter classes showed greater variability for FIA plots with volumes >2000 ft^3/ac and basal area >110 ft^2/ac (data not shown). Landsat imagery's overhead view and spatial and spectral resolution likely reduces accuracy for pixels more fully saturated by overstory tree canopies. A stronger relationship between spectral values and overstory trees, that contribute a larger proportion of the total volume and basal area, potentially explains greater accuracy for these layers.

4.2.2 Current Levels of Wood Volume in the Analysis Area

We calculated bole wood volume for the ponderosa pine type across the entire analysis area, 4,561 million ft^3, from the total cubic foot volume layer (Figure 7, Table 10). Average wood volume per acre was 1,890 ft^3 across the entire analysis area. A total of 3,263 million ft^3 was estimated for the ponderosa pine type after areas such as steep slopes, MSO PACs and other locations unlikely to be treated by mechanical thinning were removed (Table 10). A total of 26% of the analysis area was removed from the wood supply assessment for the reasons stated

above and 74% was considered to be within forest management areas where restoration treatments could potentially take place. Wood volume per acre was only slightly lower (1,830 ft^3/ac) for management areas after removing 26% of the area unlikely to be thinned.

We also estimated volume for each of the three tree diameter classes for the entire analysis area and within each landscape management area considered in the two treatment scenarios (Table 10). A roughly even proportion of the total wood volume was estimated for tree diameter classes <16" dbh (45%) and trees >16" dbh (55%) within management areas (Table 10). The wildlands management area represents the largest land area (33%) with 30% of the wood volume across the entire study area. All five forest management areas showed a similar proportion of wood volume to the size of the area included within the area (Table 10). For example, municipal watersheds were only 3% of the total area and contained 3% of the volume.

4.2.3 Predicted Wood Supply Based on Treatment Scenarios

4.2.3.1 Wood supply volume

Each landscape management area represents a portion of the analysis area where a level of mechanical thinning can potentially be implemented, therefore contributing to wood supply. The proportion of wood supply from a management area was determined by working group members (section 3.4.5). Management areas treated under the consensus scenario generated a total wood supply of 847 million ft^3 from 41% of the entire analysis area (Table 11). Thinning treatments under a scenario agreed upon by the majority of working members generated greater wood supply (1,015 million ft^3) from 74% of the analysis area (Table 11). Note that the full 74% of the analysis area is not treated under this scenario because 5% of the area was already at or below a minimum basal area condition for management areas (Table 3).

Wood volumes from the two supply scenarios did not range widely even though 33% more area was covered with potential restoration treatments under the majority scenario. Additional acres included in the majority scenario add areas with lower pre-treatment basal area yielding a lower amount of wood byproducts from mechanical thinning. Average supply volumes ranged from 611 ft^3/ac (majority) to 858 ft^3/ac (consensus) and also reflect differences due to more heterogeneous forest conditions over the larger area. It is likely that actual thinning contracts will range in supply values as with WMSP thinning contracts which removed between 109 ft^3/ac and 1,281 ft^3/ac (n = 31) for trees >5" dbh (Appendix G). Nevertheless, stewardship contracts removed 611 ft^3/ac on average (Appendix G) and were identical to the majority

scenario supply estimates (Table 11) that likely cover similar landscape-level forest structural variability. The consensus scenario wood supply estimate was also well within the range of per acre volumes and resulting wood byproducts from stewardship contracts (Table 11, Appendix G).

These figures represent wood supply from the analysis area up to the fall of 2006. Accordingly, estimates for the amount of area treated annually and tree growth during the life-span of forest restoration projects (e.g., a 10 to 30 year planning period) will be necessary to up-date wood volume estimates and yield over time.

A total of 94% of the ponderosa pine forest in the analysis area was on USDA Forest Service land and only 5% of the area distributed among private, state and BLM jurisdictions. The analysis area does not include all lands with extensive ponderosa pine forest in northern Arizona. Tribal forest jurisdictions have the potential to contribute to regional wood supply though estimates could not be obtained for these lands during the analysis period. Accordingly, the estimated wood supply for either scenario was predominately generated from four USDA Forest Service jurisdictions (Table 14).

4.2.3.2 Wood supply biomass

We calculated biomass estimates for crown material in addition to tree boles as a potential source of wood supply as market demand for these materials increases in the southwest. Total biomass weights (tree bole and crown) summarized for the wood supply analysis were similar for the consensus and majority scenarios ranging from 34.8 to 41.8 million green tons respectively (Table 13). Separate biomass estimates for tree bole[18] and crown byproducts from thinning treatments are reported in Table 13. From either of the two restoration scenarios, 23% of the total above ground biomass generated by treatments was from crown material and 77% from tree boles. That is, approximately 23% additional biomass is derived from tree crowns with restoration treatments. The amount of biomass harvested in each management area was dependant on the number of acres and level of treatment. CPMAs showed the highest biomass

[18] Tree bole weight is the cubic foot bole volume converted to green tons using a factor of 0.0315 green tons = 1000 cubic feet. Tree bole cubic foot volume or weight in green tons includes the entire length of the tree with **no** deduction from the main stem for stumps or tops at specified diameter. Crown weights from restoration byproducts include all tree foliage, limbs and bark from limbs.

removals per acre and MSO restricted habitat the lowest, parallel to supply patterns observed with cubic foot volume estimates (Table 13).

Biomass estimates from the wood supply scenarios were compared to timber cruise data from stewardship contracts that reflect recent thinning treatments in the analysis area. On average, the total above ground biomass estimated from stewardship contracts (27.9 green tons/ac) was quite similar to biomass removed from treatments simulated with the majority scenario (25.2 green tons/ac). The consensus scenario showed somewhat higher per acre supply estimates on average (35.5 green tons/ac) as treatments were targeted to areas with highest pre-treatment basal area. The majority scenario covered an additional 33% of the landscape which had lower initial basal area which decreases average per acre estimates.

Comparisons of separate crown and stem weights from wood supply estimates and WMSP cruise data must account for the different methods used for calculating biomass weights from stewardship contracts. According to contract cruise data, average green tons for harvest "residues" include all "non-merchantable"[19] trees < 5" dbh, tops and crown material from larger diameter trees and tree bole weight is for merchantable trees >5" dbh minus top and crown material (Appendix G). Crown biomass from the wood supply estimate includes only limb, bark and foliage weights that is in addition to bole weight, from the total length of the tree's main stem. Average green tons estimated as tree residues from stewardship contracts were approximately 10.7 tons/ac in comparison with 5.8 tons/ac from crown material from the majority wood supply scenario (Table 13). Tree bole material averaged 17.2 tons/ac from stewardship contracts and 19.4 tons/ac in the majority wood supply estimate. As anticipated, biomass calculations for wood supply resulted in lower estimates for crown weight and higher estimates for tree bole weight. Tree bole weights from wood supply calculations include small-diameter material (e.g., trees <5" dbh and tops <3" diameter) that were categorized as residual or non-merchantable biomass in timber cruise data from stewardship contracts.

Therefore, contracts with no thinning of trees < 5" dbh (n = 4) resulted in an average of 5.4 tons/ac in residues which more closely approximate crown weights calculated for the wood supply analysis (5.8 tons/ac). These comparisons suggest that the above biomass calculations provide a reasonable estimate of tree bole and crown weights that could potentially be generated

[19] "Non-merchantable" or "residues" refer to all harvest materials that were not considered to have a market value for the WMSP contracts.

with either of the wood supply scenarios. Biomass estimates for this report do not account for materials separated into sub-merchantable thinning byproducts (trees <5" dbh), tree tops and other categories more readily determined from site-scale assessments and timber cruise data.

Weight values reported here are general approximations for above ground biomass that would potentially be removed as a result of forest restoration treatments in the wood supply analysis area. To improve accuracy of future biomass estimates, we recommend that digital data layers be derived for both tree boles and crown biomass using the *k*-nn imputation approach. These methods would provide information on the spatial distribution of tree biomass across the study area, similar to cubic foot volume and forest structural layers. These data would afford follow-on assessment and spatially explicit analyses of wood biomass utilization, treatment costs, present and future markets and distance to processing facilities.

4.2.3.3 Wood supply from small-diameter trees

From the majority scenario, we estimated the proportion of the total area that would not attain target post-treatment basal area conditions by harvesting only trees <16" dbh. This analysis assumes 10% and 20% of the basal area is retained from trees in the <5" dbh and 5 -16" dbh classes respectively. Summaries of all forest management areas indicate that 19% of the area treated with the majority scenario (74% of landscape) would require thinning for trees >16" dbh to match the basal area distributions in Figure 4. Conversely 81% of the area treated showed that sufficient basal area can be harvested from small-diameter trees accounting for 90% of the total wood supply volume (917 million ft^3) in the majority scenario. Community protection areas had the greatest amount of area where post-treatment basal area was in surplus of what could be harvested from small-diameter trees (Table 13). The higher level of forest thinning in communities would require cutting trees >16" dbh in over half of the CPMAs though this represents only 7% of the analysis area (74% of study landscape). This analysis was conducted for only the majority scenario as even fewer acres would require thinning trees >16" dbh in the consensus scenario, which applies to a subset of the lands in the majority scenario.

5 Existing Harvesting Contractors, Mills and Manufactures

One of the tasks of this wood supply study was to define and describe the existing wood harvesting utilization industry in the analysis area. As pointed out by the Regional Forester, future multi-year stewardship contracts "will be structured to not only attract new, large

industrial users that can achieve landscape-scale treatment objectives, but also continue to supply fiber to existing local industries that have been purchasing timber sale and service contracts for many years and have been the foundation of our forest restoration programs" (Forsgren 2007b). To this end, it is important to know how much wood from what areas is supporting current utilization industries and how this affects overall supply and potential for development of additional wood utilization infrastructure for small-diameter trees.

We began the analysis of existing wood harvesting and utilization industries by collecting lists of firms thought to be operating in the region[20] from the following sources: Wood Processing Facility History and Summary in Arizona and New Mexico, 2007 (provided by USDA Forest Service Regional Office 3); Wood Product Harvesters, Processors, and Users (ERI); and White Mountain Stewardship Partnership Economic Assessment (Gibson 2007). These documents included the names and locations of about 135 firms in Arizona and New Mexico. The information gathered from these sources included everything from large logging operators and mill facilities to small firewood lots and custom woodworking shops. They also included firms that were in no way affiliated with the study area or were thought to no longer be in existence. A winnowing process was conducted whereby only those firms that were directly involved in the harvesting and processing of small-diameter ponderosa pine on the Coconino, Kaibab, and Apache-Sitgreaves National Forests remained in the analysis. The winnowed list of harvesters, mills and manufacturers was completed in consultation with staff members from the three NFs above as well as the White Mountain Stewardship Project (WMSP) administrator (Future Forest, LLC) and the Southwest Forest Products representative in Flagstaff, Arizona.

A draft set of tables were produced and sent to the three Forests, WMSP administrator, and SW Forest Products for review. We incorporated review comments in the wood volume estimates (Tables 15-18) and materials flow charts (Table 19). Harvesters removed a total of 174,200 green tons of wood byproducts from Apache-Sitgreaves National Forests in year 2006 (7.4% or 12,900 green tons of these materials were residual biomass) and another 158,500 green tons from the Coconino and Kaibab National Forests. Additional material was treated and left on site. This value may be larger for the full analysis area as non-Forest Service lands (5% of the analysis area) and two Ranger Districts on the Tonto National Forest were not included. The

[20] We contacted the following Forest Service employees for information on utilization industry and project level considerations: Carol Boyd and Kim Newbauer (Coconino NF); Jerry Drury (Kaibab NF); Kerry Nedrow, Elaine Zieroth, Mitchell White, and Ed , Collins (ASNF); and Jeff Hogg and Marlin Johnson (Regional Office 3).

total of 319,800 green tons of non-residues and 12,900 green tons of residues removed are equivalent to 1.2% of the total bole biomass and 0.2% of the total crown biomass that would potentially be generated from treatments in the consensus scenario (Table 12). These values extrapolated over 10 years would be 3,198,000 and 129,000 green tons, which is 12% and 1.6% of the respective bole and crown biomass from the consensus scenario. Uncertainties in future wood supply including tree growth or disturbances such as wildfire influence projected values.

There are two primary organizations driving utilization in the White Mountains (Apache-Sitgreaves National Forests; ASNF) and Western Mogollon areas. On the ASNF side, treatment and utilization is driven by the WMSP. The WMSP is managed and administered by Future Forest, LLC which is comprised of WB Contracting (Walker Bros. Logging) and Forest Energy. In some cases other harvesting contractors (e.g., Tri-Star Logging / S. Reidhead, Renegy) sub-contract to WB Contracting. The third harvesting contractor working in the area is Nutrioso Logging operated by J. Reidhead. The primary consumers of wood in the area are Forest Energy (WMSP/Future Forest) and Reidhead Lumber. On the western Mogollon Plateau, treatment and utilization are driven by Southwest Forest Products (SWFP). SWFP is a vertically integrated company providing over two-thirds (91K tons) of its wood requirements to itself at its facilities in Phoenix and Ash Fork. The remaining 42K tons are harvested by three other contractors (Perkins from nearby Williams, Colorado Wood from Snowflake, and Hurd Bros. from Chama, NM).

6 Additional Considerations

Several analyses were performed as part of this project that did not explicitly affect wood supply estimates based on year 2006 conditions, including a review or forest growth models and several fire modeling exercises designed to identify locations appropriate for fire-only treatments. However, existing levels of harvesting and utilization are important to consider in developing new stewardship contracts. In addition, several factors were discussed that are likely to impact wood supply estimates, such as climate change, however due to high levels of uncertainty and lack of data, they were not quantified. We summarize these topics and modeling efforts in this section.

6.1 Fire as an Initial Treatment Option

With the collaborative process deciding to look at the entire study area and identify areas that would be excluded from mechanical thinning treatments, the issue of where prescribed and/or wildland fire could or should be used as the initial treatment option to restore fire-adapted ecosystems was raised. A "fire" subcommittee was formed to evaluate approaches to address this issue, although several working group members did not believe it was appropriate to address the subject of fire in the wood supply analysis. It should be noted that virtually all mechanical thinning treatments are followed by broadcast burns for ecosystem restoration and maintenance. The fire group focused solely on locating areas on which fire-only was the preferred restoration treatment.

Initially, the fire subcommittee considered using spatial data provided by the interagency LANDFIRE program and the fire behavior modeling program FlamMap to identify specific areas (i.e., 30-m pixels) on the landscape where existing forest structural conditions (e.g., crown-base height, crown bulk density, canopy cover) would permit the safe application of prescribed fire as a first treatment option. Specifically, it was the hope of the subcommittee that areas predicted by fire models to be representative of a surface fire condition would allow fire to be safely reintroduced without fuel reduction by mechanical means. To develop predictive models of fire behavior over the large spatial extent of the wood supply study area, the ForestERA team collaborated with researchers (Chuck McHugh and Laurie Kurth) from the USDA Forest Service Fire Sciences Lab in Missoula, Montana. The resultant fire behavior models and GIS-based maps were implemented under multiple weather scenarios (e.g., 95^{th} and 97^{th} percentile weather conditions for the central Mogollon Plateau). Appropriate weather and forest structure parameters were also vetted by regional fire behavior experts (e.g., Pete Fulé (Appendix H), NAU/ERI and Linda Wadleigh, Region 3 Forest Service). Model results and group-defined iterations were presented over the course of several subcommittee and full working group discussions. Given these results, many members of the working group believed that agreement could not be reached regarding the threshold values at which existing forest structure conditions would permit a safe and reasonable reintroduction of fire on the landscape. When maps of predicted fire behavior across the study area were presented, a few members were able to identify that specific areas modeled as exhibiting surface fire behavior, for example, had instead exhibited crown fire behavior during recent wildfire events. Even under less-than-extreme

weather scenarios, it was difficult for some members to consider models of predicted fire behavior as an acceptable tool for identifying areas appropriate for fire-only restoration methods. Time constraints added to the difficulty of using the fire models to effectively identify thresholds for prescribed burning and wildland fire use as an initial restoration treatment. Additional work in this area is warranted.

Beyond spatial models of predicted fire behavior, other approaches to defining fire-only treatment areas were also considered during subcommittee discussions and presented to the working group, including: 1) identifying areas with a specified basal area derived from pre-settlement conditions where fire would be a ground fire; 2) identifying areas where both medium to high basal areas and low numbers of trees per acre exist (assuming this would be mature, open forest conditions with a few large trees); 3) applying a percentage reduction to the landscape derived from an analysis of acres where mechanical thinning verses fire-only treatments were proposed for completed or pending Forest Service projects; and 4) using a percentage (65%) of the landscape that is burned, verses mechanically thinned, modeled after the Gila National Forest in western New Mexico, which has an aggressive fire management program.

As with the fire modeling approach described above, determining numeric threshold values (e.g., basal area and/or tree density) where forest structure attributes conducive to surface fire could be reasonably defined became problematic for the group to reconcile. A complicating factor threaded throughout the discussions was the applicability, acceptability and predictable effects of fire and smoke in CPMAs, wildlands, and MSO habitat. Concerns were raised that adverse health effects of smoke and exceeding air quality thresholds will limit prescribed burning activities. Smoke production is expected to be greater where fire is used an initial treatment than when prescribed burning follows thinning. Thus, the subcommittee decided to not recommend a specific approach or number (i.e., value(s) for basal area and/or tree density) to the entire working group. Instead, the subcommittee advocated a) that there are areas of the landscape where fire only will be the preferred treatment and mechanical thinning is not desirable, b) that decisions about these areas are project specific and determined during NEPA analysis, and c) that resulting wood supply volumes will need to be adjusted downward to accommodate the realistic and observed impact of fire-only treatments on the landscape.

The full group also discussed that the review of 27 Environmental Assessments found that 33% of NEPA planning areas (part of the 37% assigned no thinning treatments, Table 8)

either had been burned or were approved via NEPA to be burned. There was some acknowledgement, however, that these areas do not often actually receive fire-only treatments for various reasons. The full working group acknowledged that fire-only treatment are currently being planned and carried out, however they did not agree on a specific level or locations. It was noted from the discussion that the consensus scenario affords additional land areas over the majority scenario for potential prescribed fire-only treatments or Wildland Fire Use (WFU).

6.2 Tree Mortality and Climate Change

There are several factors that could not be included in the wood supply analysis due to lack of data or uncertainty about the magnitude of their impacts, for example the inability to predict the timing and location of large events, such as crown fire, drought, and insect outbreaks. It is likely that wildfires and WFU fires will burn some percentage of the estimated wood supply, but the working group agreed that there was no adequate information to quantify the risk or likely consequences of these stochastic events. Similarly, the working group expects that pest infestations, drought, and climate change may also -- either singularly or by exacerbating the effect of one another -- reduce the amount of wood supply available for mechanical treatment, but did not have sufficient predictive ability to include in this analysis. This anticipated reduction of supply should be considered when interpreting the wood supply estimate and adjustments to the estimate will be necessary in the future, as the extent of climatic factors – and progress in implementing treatments or other forest disturbances – become known. In this respect, the working group strongly recommends that the harvest of small-diameter timber from these forests be conducted in an adaptive management framework.

6.3 Old-growth Trees

Old-growth trees (those that became established before Euro-American settlement or currently exhibit old-growth structural characteristics e.g., yellow platy bark) are rare and under represented in the ponderosa pine forests of the Southwest (Moir and Dietrich 1988, Kaufman et al. 1992), therefore it is imperative to take action to conserve and manage them to stave off further attrition. In addition, forest management that leads to the recruitment and development of old-growth trees and the structural attributes that characterize old trees is important for overall forest health and the persistence and vitality of biodiversity (Kaufman et al. 1992).

No reliable methods have been developed to assess old-growth trees at the scale of the wood supply analysis area, with the remote sensing and GIS applications applied with this study.

Old-growth forest conditions were not specifically addressed with the wood supply analysis. Therefore, the collaborative group has chosen to express qualitatively what they believe should be management activities with respect to old-growth old trees. The group recognizes that unnatural, crown fire and competition from small trees are two of the biggest threats to old-growth survival in Arizona today (Covington and Moore 1994). Old-growth trees are typically surrounded by irruptions of younger and smaller trees that act as ladder fuel during fire. Old-growth trees also suffer from competition with these dense younger trees for water and nutrients. Consequently, the group supports management action that seeks to restore old-growth structure by retaining all pre-settlement trees (no matter what their diameter), thins and removes post-settlement trees from below, and carefully reintroduces fire taking precautions to remove excess fuels from around old trees before burning.

6.4 Forest Growth Review and Recommendations

A project deliverable for the wood supply analysis was to identify region specific forest growth models and provide technical information about their use. Forest growth modeling was not explicitly integrated into analyses of future wood supply for this report. A tree growth model (i.e., FVS) was used to project ground reference plots forward to match Landsat TM image dates and impute forest volume and structural layers for year 2006. The objective of the following section is to outline major forest growth model types and their potential application for projecting future wood supply in the present analysis area.

Forest growth models fall into two major categories of empirically derived growth and yield models and mechanistic process-based models. The former category has been widely used by forest managers while the latter is more commonly applied for scientific research. Mechanistic models that integrate climate data, nutrient cycling and plant respiration processes to predict forest growth have received less attention by forest managers. Nevertheless, adaptations to include biogeochemical cycling (BGC) as an extension of empirical models have been recently developed (Peng 2000). A BGC extension to forest growth models currently used in the southwest is discussed below.

Peng (2000) provides a thorough review of past, present and future growth modeling approaches applied to uneven-aged forest systems, that includes models commonly applied to North American forest types. For this report, we provide a brief overview of empirical models used for making forest growth predictions in southwestern forest types, their inputs, assumptions

and extended capabilities (e.g., disturbance, BGC and forest management extensions). We distinguish "traditional" forest growth models from succession models which are used to project forest development stages and composition changes. While succession models are useful to determine the status of forest development, they are less frequently applied to determine tree growth and changes in wood volume. Linkages between empirical growth models and simulating forest succession are, nevertheless, important to landscape planning (Teck et al. 1996, Sesnie and Bailey 2003). Data requirements for integrating empirical and landscape succession models for predicting large area forest changes may limit these approaches. Nevertheless, data integration and remote sensing applications are quickly being developed to fill such information voids (Remmel et al. 2005, Lefsky et al. 2002, Vanclay 2003).

The Forest Vegetation Simulator (FVS), a forest growth modeling framework currently maintained by the USDA Forest Service, is highlighted in this review due to its widespread application and support (Teck et al. 1996). FVS contains over 20 region specific variants of forest growth models accessed through a common interface, SUPPOSE (Crookston 1997). While FVS and the SUPPOSE interface is a relatively new forest modeling toolkit, its predecessor Prognosis has been in use since the 1970s (Stage 1973) and iteratively improved (Wykoff et al. 1982). Tree population data from forest plots with measurements such as tree diameter, crown ratio, age and site index serve as inputs to FVS. Therefore, implementing growth simulations with FVS relies on forest inventory data that is typically collected on the ground. The USDA Forest Service Forest Inventory and Analysis Program (FIA) currently provide inventory data in a format utilized by FVS to facilitate plot summary and simulation modeling. FVS software (http://www.fs.fed.us/fmsc/fvs/) and FIA data (http://www.ncrs2.fs.fed.us/4801/fiadb/fim21/wcfim21.asp) can be freely downloaded via the internet and provide a base set of information used for regional forest biomass and carbon assessments (Fried et al. 2005, Hickey et al. 2007). From a practical standpoint, FVS is capable of quickly processing several thousand forest plots at a time with database features to link outputs to spatial data layers in a GIS (Peng 2000).

For southwestern coniferous forests, the Central Rockies FVS (CR-FVS) variant accesses the GENGYM stand table projection system (Edminster et al. 1991). GENGYM and model relationships are calibrated with tree data taken from plots established in major southwest forest types to predict tree diameter growth, height, crown ratio and mortality. GENGYM and its

adaptation to FVS have several features important to modern forest management applications in the southwest. Forest measurement plots and tree data used for developing tree growth regression equations were collected from even and uneven-aged stands on the Apache-Sitgreaves, Lincoln, Carson, Kaibab and Santa Fe National Forests (Edminster et al. 1991). It is a distance-independent, individual tree model calibrated for each tree species, or species groups in the case of hardwood trees and shrubs (Edminster et al. 1991). Therefore, it is capable of predicting growth in both even and uneven-aged forest conditions and in pure and mixed species compositions. As a distance-independent model, it does not require coordinates for individual trees that are typically unavailable from forest inventories. These innovations are clearly an advantage over earlier whole stand models such as RMYLD (Edminster 1978) and ASPNORM (Mowrer 1986) that are designed for even-age forest structure and homogeneous species composition.

A potential limitation of FVS, as with many forest growth models, is the deterministic manner in which trees are grown into the future (Vanclay 2003). Calibration data for models are derived from tree core data reflecting past forest growth, though tree rings are expected to contain variation in growing conditions due to soil factors, inter-annual climate shifts and temporal changes in water availability (e.g., periodic drought). Nevertheless, tree growth and mortality assumptions may not reflect future climate conditions and subsequent changes tree growth. Net growth can be influenced by a number of factors including climate, soils, insects and disease, fire and mortality (Vanclay 2003, Abella and Covington 2006). To address these issues, a BGC extension the FVS empirical models incorporates daily climate data and its effect on individual tree physiology (http://www.fs.fed.us/foresthealth/technology/bgc_model.shtml). The FVS-BGC extension is currently under evaluation and requires daily temperature and precipitation data as inputs in addition to tree measurements. Once calibrated, processes based models are anticipated to enhance empirical model relationships to further incorporate climate change and its impact on tree growth. Disturbance extensions that include fire occurrence, insect outbreaks and tree disease factors have also been incorporated into FVS and can be integrated to simulation scenarios. As a practical tool to perform forest management simulations, tree harvest and prescribed burning can also be implemented to determine impacts on future forest growth and yield.

For the present wood supply analysis, we used FVS model runs with FIA plot data (n = 327) to estimate future growth in ponderosa pine forest type. Plots from years 1995 to 1997 for the Coconino, Apache-Sitgreaves, Kaibab and Tonto National Forests were projected to 2007 and 2027. Tree growth from these runs averaged 40 ft^3/ac/yr up to 2007 and 38.9 ft^3/ac/yr between 2007 and 2027, minus volume was lost due to mortality (Table 20). Quadratic mean diameter (QMD) increment averaged 0.076 in/yr and ranged from 0.013 to 0.202 in/yr. These figures are comparable to diameter growth increments from 66 plots in Northern Arizona on a range of soil conditions reported by Abella and Covington (2006) that showed 0.091 to 0.169 in/yr in predominantly open ponderosa pine stands. For our analysis, a large number of FIA plots were used crossing a greater diversity of site and forest conditions, which likely explains a wider range in annual growth increment.

Average volume and mortality accumulation from FVS runs within the three tree diameter categories used for the wood supply analysis are also included in Table 20. These data reflect the difference in total cubic foot volume for live and dead standing trees in each diameter class at the end of 10- and 20-year FVS cycles.

From these cursory evaluations, we consider FVS growth predictions with FIA data capable of producing an accurate estimate of future wood volume. Relatively short 10 and 30-year simulation cycles can potentially avoid some uncertainty about future forest growth conditions and climate changes. Applications to project forest growth across the entire wood supply study area and ponderosa pine type would necessarily require additional assumptions for making landscape- or region-scale projections. Forest growth estimates incorporating information such as an estimated annual rate of tree thinning and prioritized treatment locations would enhance wood supply estimates over a specified planning period. Differing site conditions such as soil type, topography, elevation, climate and solar radiation will likely need to be integrated into future growth estimates at this scale (Abella and Covington 2006).

7 Concluding Remarks

A primary goal of the wood supply analysis was to build agreement on ecologically appropriate forest restoration treatments, across the study area, which could supply wood byproducts to new and existing businesses and markets. The fact that the working group reached consensus over 67% of the landscape (26% not appropriate as a source, 41% appropriate for mechanical

thinning) is remarkable. The group also agreed that community fire protection was important and agreed on the intensity of mechanical treatments that could be applied within five landscape management areas. Where a difference of opinion occurred on the method by which an additional 33% of the landscape should be restored, such as with the use of natural or prescribed fire-only treatments versus mechanical thinning, the estimated bole volume of wood byproducts potentially available differed by only 16% (ranging from 850 to 1,015 million ft^3).

The values derived in this study present a snap shot of currently available wood supply, however, a review of forest growth models was conducted to assist with future projections. Including forest growth would increase supply estimates over time, however the study also identified several factors which could lower the estimated wood supply, including lack of complete data on current road conditions and access, presence of archeological sites, and other project-level considerations. In addition, uncertainty in actual future wood supply due to climate change and disturbances such as wildfire, insect outbreaks and drought-related mortality were recognized. Because many factors are considered in choosing treatment locations, the group did not specify or prioritize project boundaries for their treatment scenarios, and actual wood supply values will shift according to decisions made during the NEPA process. Also, when developing new stewardship contracts it should be taken into consideration that these estimates include restoration byproducts from some remaining areas already dedicated to the White Mountain Stewardship contract, which is estimated to treat upwards of 120,000 additional acres. As the exact contract treatment areas were not available at the time of this analysis, it was not possible to exclude their contribution to wood supply estimates. The volume of small-diameter logs and wood byproducts potentially available from restoration treatments exceeds current market demand. In 2006 existing harvesters, mills and manufacturers in the analysis area removed and utilized 1.2% of the bole biomass (or 12% extrapolated over 10 years) that would potentially be generated from consensus scenario treatments.

Over the course of the project, additional studies and planning efforts, such as those needed to prioritize treatments and specify their preferred sequencing over time, and to assess wood supply from pinyon-juniper ecosystems, were discussed and recommendations were made (see Appendix I). As indicated in communications from the USDA Forest Service, Region 3, the results of this study will be used to assist in management decisions and the development of

multi-year forest stewardship contracts to attract new industrial users, and to supply wood fiber to existing local wood product businesses.

8 Acknowledgements

This analysis was funded by the Southwestern Region of the USDA Forest Service and 95% of the analysis area includes USDA Forest Service lands. Any decisions on these lands must be consistent with the National Forest Management Act (NFMA) and NEPA requirements. The wood supply analysis does not meet the requirements of the NFMA for timber suitability analysis; this will be done in the appropriate Forest Plan revisions. Future projects will conduct NEPA analysis and will be consistent with the Forest Plans.

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Table 1. List of wood supply working group members and affiliations.

Name	Position	Affiliation
Ethan Aumack	Director of Restoration Programs	Grand Canyon Trust
Pascal Berlioux	President and Chief Executive Officer	Arizona Forest Restoration Products Inc.
Kim Newbauer	Timber Sale CO	Coconino National Forest
Rob Davis*	President / Owner	Forest Energy / Future Forests
Paul DeClay	Tribal Forester	White Mtn. Apache Tribal Forestry
Jerry Drury	Timber Staff Officer	Kaibab National Forest
Steve Gatewood*	Owner / Consultant	WildWood Consulting, LLC representing Greater Flagstaff Forests Partnership
Bill Greenwood	City Manager	Town of Eagar
Shaula Hedwall	Senior Fish and Wildlife Biologist	U.S. Fish & Wildlife Service
Scott Higginson	Executive Vice President	NZ Legacy, LLC / Snowflake White Mountain Power / Renegy, LLC
Herb Hopper	Community-based forest and wood products advocate	Little Colorado Plateau Resource, Conservation & Development
Robert LaCapa	Forest Manager	Fort Apache Agency, Branch of Forestry, Bureau of Indian Affairs, Department of the Interior
Sarah Lantz	Urban Wildlife Planner	Arizona Game & Fish Department, Region II, Flagstaff Office
Lisa McNeilly	Northern Arizona Program Director	The Nature Conservancy
Keith Pajkos	Timber Staff	Arizona State Lands Department, Forestry Division
Chuck Peone, Jr.		Fort Apache Timber Company
Molly Pitts	Community-based forest and wood products advocate / consulting forester	Northern Arizona Wood Products Association
Todd Schulke*	Forest Programs Director	Center for Biological Diversity
Larry Stephenson	Executive Director	Eastern Arizona Counties (ECO) / Economic Environmental Counties Organization (EECO)
Diane Vosick*	Associate Director	Ecological Restoration Institute
Elaine Zieroth*	Forest Supervisor	Apache-Sitgreaves National Forests

* Steering Committee Members

Table 2. Working group meeting schedule and level of attendance at each meeting.

Meeting No.	Date	Time	Location	No. of Participants
1	June 4, 2007	9am - 4:15pm (PST)	Northland Pioneer College, Painted Desert Campus, 2251 N. Navajo Blvd., Holbrook, AZ	16
2	July 18, 2007	9am - 4:15pm (PST)	AZ Game and Fish Dept. Pinetop Regional Office Conference Room 2878 E. White Mtn. Blvd. Pinetop, AZ (Directions)	16
3	Aug. 17, 2007	9am - 4:15pm (PST)	Northern Arizona University, Applied Research & Development, 1298 S. Knoles Drive, Bld. 56, Large Pod Conference Room, University Drive, Flagstaff, AZ	18
4	Sept. 17, 2007	9am - 4:15pm (PST)	Northland Pioneer College, Painted Desert Campus, 2251 N. Navajo Blvd., Holbrook, AZ	14
5	Oct. 15, 2007	9am - 4:15pm (PST)	AZ Game and Fish Dept. Pinetop Regional Office Conference Room 2878 E. White Mtn. Blvd. Pinetop, AZ (Directions)	15
6	Nov. 16, 2007	9am - 4:15pm (MST)	Northern Arizona University, Applied Research & Development, Bld. 56, Large Pod Conference Room, University Drive, Flagstaff, AZ	16
7	Nov. 29, 2007	9am - 4:15pm (MST)	Northern Arizona University, Applied Research & Development, Bld. 56, Large Pod Conference Room, University Drive, Flagstaff, AZ	17

Table 3. Management objectives, desired post-treatment conditions, management actions, and criteria layers used by the working group to define land management areas, areas not considered a source of restoration byproducts and areas of special consideration.

Overall objectives of working group treatment scenarios: 1) Restore fire-adapted (ponderosa-pine) ecosystems[21] and protect communities from destructive fires while mitigating adverse impacts of treatments on soils, surface water and wildlife. 2) Based on restoration needs, define potential mechanical thinning treatments for use in estimating the supply of wood byproducts. Note: The USDA Forest Service's adoption of the "Management Recommendations for the northern goshawk in the southwestern United States" under the 1996 Regional Forest Plan Amendments guide management actions on all forest lands outside of Mexican spotted owl (MSO) or other federally listed species habitat.

POTENTIAL RESTORATION BYPRODUCTS FROM LANDSCAPE MANAGEMENT AREAS

Rank[22]	Landscape management areas: Management objective	Desired Post-Treatment Conditions[23]	Management Action[24]	Criteria Layers[25]
1	**Community protection management area (CPMA)**: In areas close to communities where tolerance for fire is low, reduce predicted fire behavior to acceptable levels (achieve low end of surface fire). Maintain a range of forest conditions (e.g., basal area) across the landscape. To define CPMA assign a ¼-mile protection buffer around all private lands with an additional ½-mile protection buffer extending to 1½-mile upwind of all private property within "high priority" areas identified in CWPPs. Protect infrastructure from severe crown fire by following FERC guidelines for power and gas line fire protection. Follow ADOT guidelines for right of way safety zone on either side of roads.	Basal area: 30-60 ft^2/ac (distributed according to a skewed bell-shaped curve more heavily weighted to lower values with a high point, or mode, at 40 ft^2/ac) Density: 40-60 trees/ac (50 avg) Canopy cover: 30-40% (35% avg)	Heavy thinning followed by prescribed fire[26] (light burn) near communities.[27] Feather intensity with distance from communities (higher intensity thinning immediately adjacent to communities). Apply heavy thinning in areas near power lines (50 ft from high voltage lines), gas lines, and roads (42 ft from highways, 30 ft from other roads) as stated in FERC and ADOT guidelines for fire protection of these features.	Community Wildfire Protection Plan (CWPP) priority areas, private lands, state and federal highways and utility corridors (power lines). Gas line data was not available.

[21] Areas once dominated by ponderosa-pine that mixed-conifers have expanded into are not considered in this study.
[22] Factors with higher rank (lower value) trump factors with lower rank. For example, a factor with a rank of one takes precedence over another with rank 2 occurring in the same location. Areas not considered a source of wood supply are given a rank of zero and take precedence over all landscape zones.
[23] Desired post-treatment condition expressed in terms of ranges of forest structural attributes. Basal area is the attribute of most interest. Density and canopy cover are guidelines.
[24] Goshawk guidelines (RMRS General Technical Report, RM-217, 1992) dictate management actions on all forest lands outside of MSO or other federally listed species habitat. The desired post-treatment conditions in column 2 take precedence over the thinning levels in this column as the group ended up choosing basal area distributions to define post-treatment conditions.
[25] Criteria layers used to represent landscape feature.
[26] Burn where appropriate following ponderosa pine thinning in riparian areas.
[27] Where smoke concerns are high or difficult to mitigate, haul wood off-site.

POTENTIAL RESTORATION BYPRODUCTS FROM LANDSCAPE MANAGEMENT AREAS (Cont.)

Rank[22]	Landscape management areas: Management objective	Desired Post-Treatment Conditions[23]	Management Action[24]	Criteria Layers[25]
2[28]	**MSO Restricted Habitat:** Implement current (1996) Forest Plans and 1995 MSO Recovery Plan.[29] Follow MSO Recovery Plan guidelines for restricted habitat. See Recovery Plan Table III.B.1 for target/threshold conditions.	Basal area: 45-190 ft^2/ac (100 mode)	Light to moderate in other restricted.	Pine-oak habitat
3	**Municipal watersheds:** Protect watersheds (6th order) containing municipal surface water supplies from the effects of high severity crown fire (including increased sedimentation risk). Allow torching (passive crown fire).	Basal area: 40-120 ft^2/ac (60 mode) Density: 20-300 trees/ac (160 avg) Canopy cover: 30-60% (45% avg) (ranges are more heavily weighted to lower values)	Apply light to heavy thinning treatments followed by prescribed fire (light burn)	Watersheds containing municipal surface water supplies (6th level watersheds)
4	**Aquatic species watersheds:** Protect watersheds (6th order) containing sensitive (special consideration) aquatic species and directly feeding into their perennial water habitat from the effects of high severity crown fire (including increased sedimentation risk).	Basal area: 40-120 ft^2/ac (60 mode) Density: 20-300 trees/ac (160 avg) Canopy cover: 30-60% (45% avg) (ranges are more heavily weighted to lower values)	Apply light to heavy thinning treatments thinning followed by prescribed fire (light burn)	TNC native fish layer and 6th level watershed boundaries
5	**Wildlands**: Reduce the occurrence of high severity fire (unnaturally severe; uncharacteristic for the site). Reduce predicted fire behavior in areas predicted to actively or passively crown to a mix of surface and low intensity passive fire throughout the analysis area. Maintain a range of forest conditions (e.g., basal area) across the landscape to support wildlife and other forest resources.	Basal area: 40-160 ft^2/ac (80 mode)[30] Density: 20-300 trees/ac (160 avg) Canopy cover: 40-80% (60% avg) (ranges are more heavily weighted to lower values)	Light to heavy thinning followed by prescribed fire (light burn) in wildlands (defined as areas outside of community protection management areas and other landscape features).	"Wildlands" are defined as all parts of study area not in one of the other four management areas.

[28] Where community fire protection goals are not met in WUI, the USDA Forest Service may increase thinning levels in MSO habitat following consultation with the U.S. Fish and Wildlife Service.

[29] US Fish and Wildlife Service uses an ESA mandated layer for "MSO Designated Critical Habitat" based on coarser and older vegetation layers than available currently. Purpose is to maintain and enhance the primary constituent elements within designated critical habitat that meets the definition of protected or restricted habitat.

[30] Although not modeled spatially, the working group recommends applying the lower end of wildlands DPTC range (40-60 ft^2/ac) to top edges of canyons to reduce the rate of spread of fire in these areas and increase suppression effectiveness.

AREAS NOT CONSIDERED A SOURCE OF RESTORATION BYPRODUCTS

Rank	**Landscape feature:** Management Objective	**Management Action**	**Criteria Layers**
0	**MSO PACs:** Minimize treatment impacts on Mexican spotted owl Protected Actively Centers[31] (MSO PACs) and follow MSO Recovery Plan guidelines to avoid treatments on at least 90% of PACs until more is known of impacts.[32]	Do not consider PACs a source of wood supply (do not specify treatments in these areas) as they are expected to contribute little to overall wood supply.[4]	MSO PACs
0	**Specially Designated Areas:** Follow existing land mgmt regulations for SDAs and Inventoried Roadless Areas (e.g., restrictions on road building and use of mechanized equipment).	Do not consider Specially Designated Areas and Inventoried Roadless Areas a source of wood supply (do not specify a particular treatment in these areas).	Specially Designated Areas and Inventoried Roadless Areas
0	**Steep slopes:** Minimize the impact of mechanized equipment on soils and consider the need for specialized equipment, operator training and administrative approvals on steep slopes.	Do not consider areas with steep slopes (slope > 40%) a source of wood supply (do not specify a particular treatment in these areas as little wood will realistically be removed from them).	Slope
0	**Treated areas:** Use completed/under contract treatment location, type and intensity to inform where and how forest structure has changed. Consider areas where treatments are planned or marked as a source of wood supply.[33]	Do not consider areas with completed or under contract treatments of moderate intensity or greater that have taken place in the last 10 years as a source of wood supply.	Treatments completed and under contract
0	**Northern goshawk nest areas:** Follow goshawk guidelines.	Six nest areas, each 30 acres in size for a minimum 180 acres should be identified within each post-fledgling area (PFA). Do not consider these areas a source of wood supply.	Goshawk nest sites and PFAs
0	**Soils with mechanized treatment limitations:** Avoid mechanized management activities on sensitive soils.	Do not consider soils with limits on mechanical treatment a source of wood supply.	Terrestrial Ecosystem Survey units
0	**Streamside management zones:** Maintain and protect filter strips next to streams from potentially negative impacts of mechanized equipment.	Do not consider areas within 100 feet of perennial and intermittent streams a source of wood supply.	Perennial and intermittent[34] streams

[31] Mexican spotted owl Protected Actively Centers (PACs) are 600 acre areas within which owls have been found to be nesting.
[32] Trees < 9" dbh may be removed in PACs, so there is potential wood supply from PACs, but it is minimal.
[33] Planned and marked Stewardship contract areas will be considered a source of wood supply, but tallied separately as they have already been allocated.
[34] Place streamside management zones around perennial streams (not intermittent) for all Forests, except the ASNF, as data that differentiates between intermittent and ephemeral streams exist only for the ASNF.

AREAS OF SPECIAL CONSIDERATION

Landscape feature: Management Objective	Management Suggestions	Criteria Layers
Use fire as a restoration tool where practicable: Minimize short term ecological costs of thinning treatments which decrease resilience of the system (e.g., soil compaction and erosion, wildlife disturbance) in areas where burn only treatments are potentially feasible.	Consider fire-only treatments where feasible.	n/a
Areas not accessible from current roads: Areas greater than ¼ mile from existing roads are difficult to access with harvesting equipment in common use in the study area. New roads would likely need to be constructed to reach these areas with associated environmental impacts, however harvesting technologies used in the area may shift over the next 20 years resulting in increased access to the entire area with minimal new road construction and thus lowered environmental impacts. The working group has less confidence that these areas will be a source of wood supply.	Minimize environmental impacts associated with new road construction and road improvements necessary for harvesting.	Forest Service and TIGER roads

Table 4. Areas not considered a source of wood byproducts from mechanical restoration treatments and areas of special consideration (PAC = Protected Activity Center).

	Acres
1. Mexican Spotted Owl PACs	182,000
2. Specially Designated Areas	177,000
3. Steep slopes (>40%)	147,000
4. Contracted and completed treatments	113,000
5. Northern goshawk nest areas	63,000
6. Soil restricted from mechanized treatment	126,000
7. Streamside management zones	52,000
Total Acres (including overlap)	860,000
Spatial overlap among all layers	-222,000
Total Acres (excluding overlap)	638,000
Ponderosa-pine lands in study area	2,413,000
Ponderosa-pine lands remaining	1,775,000
Areas of Special Consideration	
Areas over ¼ mi. from existing roads[35]	241,000
Remaining White Mountain Stewardship Contract Areas[36]	120,000

Table 5. Landscape management areas and percent of full analysis and wood source areas occupied by each.

Landscape management areas	Areas w/o removals (acres)	% of Wood Source Area	Areas w/ removals (acres)	% of Analysis Area
Not considered source of wood	n/a	n/a	638,000	26%
Community protection	451,000	20%	355,000	15%
Mexican spotted owl restricted habitat	381,000	13%	237,000	10%
Municipal watersheds	86,000	3%	60,000	2%
Aquatic species watersheds	527,000	18%	334,000	14%
Wildlands	968,000	46%	788,000	33%
Ponderosa-pine dominated lands in full analysis area	2,413,000		2,413,000	100%
Ponderosa-pine dominated lands that are a potential source of restoration byproducts	1,775,000	100%		

[35] Group has low confidence of these being a source of wood supply, however no changes in wood supply volume or biomass estimates were made to account for lack of current road access.

[36] ASNF estimate of areas remaining to be treated, however no upper acreage is specified in contract. As the exact location of these areas within the NEPA Analysis Areas has yet to be determined, no wood supply volume estimate has been made. These 120,000 acres are in addition to the 113,000 acres listed in Table 5, which include areas already that have already been thinned as part of the Stewardship or other contracts.

Table 6. Treatment characterizations which consider a level of forest "fuels reduction" and restoration for the ponderosa pine type in the study area.

Thinning Level	Stem density[1] (% reduction)	Basal area[1] (% reduction)	Canopy closure[1] (% reduction)	Description
1/ Heavy thinning followed by prescribed burning	80 (70-90)	60 (50-70)	40 (25-55)	Representative of a "full" restoration, heavy fuels reduction, multi-age group selection, or WUI-based treatment.
2/ Moderate thinning following by prescribed burning	65 (55-75)	40 (30-50)	30 (15-45)	Representative of a "moderate" or "full" restoration, moderate fuels reduction, or WUI-based treatment.
3/ Light thinning following by prescribed burning	50 (40-60)	20 (10-30)	20 (15-25)	Representative of a "light" restoration or fuels "maintenance" treatment.

[1]Forest structure metrics and mean percent reduction values used to parameterize landscape-scale treatment alternatives. Minimum and maximum values in parentheses are derived from published studies and expert opinion.

Table 7. Percent reduction in basal area following application of desired post-treatment basal area distributions

Landscape Management Areas	Thinning Range (Table 7)	Dominant Thinning Level	Average	Median	StdDev	Min	Max
Community Protection	Light to Heavy	Heavy	60%	64%	14%	3%	79%
MSO Restricted	Light to Moderate	Light	19%	20%	5%	2%	35%
Municipal Watersheds	Light to Heavy	Moderate	41%	45%	11%	2%	53%
Aquatic species watersheds	Light to Heavy	Moderate	41%	43%	11%	2%	58%
Wildlands	Light to Moderate	Light to Moderate	25%	25%	8%	2%	44%

Table 8. Areas not thinned in 27 completed or planned projects in the analysis area based on a review of Environmental Assessments.

	Project Name	Planning Area (acres)	Area not thinned (acres)	Area not thinned (%)	Fire-only Areas (acres)	Fire-only Area (%)
1	Eastside*	19,977	12,356	62%	12,356	62%
2	Mormon Lake	2,799	293	10%	301	11%
3	Kachina*	6,229	1,429	23%	1,429	23%
4	Munds Park*	2,980	1,998	67%	1,988	67%
5	Mountainaire	13,979	1,476	11%	1,476	11%
6	Rocky Park*	13,678	8,000	58%	8,000	58%
7	Woody Ridge	11,543	2,945	26%	2,945	26%
8	Smith/Schultz*	11,700	1,103	9%	700	6%
9	Upper Beaver*	44,694	27,072	61%	30,414	68%
10	Victorine*	8,678	6,922	80%	6,922	80%
11	Huffer*	1,146	-	0%	-	0%
12	Elk Park	6,485	1,785	28%	1,700	26%
13	East Clear Creek*	16,228	-	0%	-	0%
14	Ft. Valley*	6,960	2,900	42%	1,800	26%
15	Blue R. MSO*	16,282	8,124	50%	2,399	15%
16	Chitty Creek*	13,076	11,676	89%	12,600	96%
17	Greer*	19,629	-	0%	-	0%
18	Eager South	17,543	3,816	22%	3,233	18%
19	Nutrioso[37]	37,171	8,595	23%	5,687	18%
20	Long Jim*	1,375	662	48%	462	34%
21	Twin*	14,900	14,518	97%	14,518	97%
22	Jacob Ryan*	33,103	9,149	28%	9,149	28%
23	East Rim*	9,630	4,307	45%	1,440	15%
24	Dogtown*	7,317	2,250	31%	2,000	27%
25	City*	12,359	3,780	31%	3,263	26%
26	Nagel*	18,770	5,751	31%	5,751	31%
27	Los Burros*	23,798	4,262	18%	3,790	16%
	Average:			**37%**		**33%**

* Acres not thinned and treatment areas provided by Grand Canyon Trust.

[37] Nutrioso: A total NEPA areas (FS lands) excluding meadows & riparian/water & PJ of 31,094 acres was used in fire-only % calculation

Table 9. Summary and error statistics for each forest structure and volume layer comparing reference and imputed values from FIA plots (n=420) in the ponderosa pine type. Data ranges are from a minimum of ~0 to the maximum value reported in the table.

Response variable	**Mean**	**Range**	**SD**	**r^2**	**Mean residual error 80% of data**	**SD**	**Mean residual error 50% of data**	**SD**
Basal area (ft/ac^2)	118	234	51	0.77	±9 ft^2/ac	4.5	±5 ft^2/ac	2.8
Density (tpa)	675	5724	831	0.74	±62 trees/ac	46.2	±31 trees/ac	19
Canopy cover (%)	42	83	15	0.56	±2.7%	2.1	±1.4%	1.0
Total volume (ft^3/ac)	2091	8135	1221	0.86	±189 ft^3/ac	132	±96 ft^3/ac	59
Vol. <5" dbh	63	798	105	0.46	±15 ft^3/ac	16	±4 ft^3/ac	6
Vol. 5 - 16" dbh	1069	3139	675	0.41	±197 ft^3/ac	140	±104 ft^3/ac	70
Vol. >16" dbh	959	6479	968	0.68	±184 ft^3/ac	115	±97 ft^3/ac	78
Vol. <16" dbh	1132	3206	695	0.53	±180 ft^3/ac	126	±96 ft^3/ac	61

Table 10. Wood volume estimates summarized by total volume and three diameter classes for year 2006[1]. The total wood volume layer was used to summarize cubic foot volume for the ponderosa pine type and each landscape management area in the study area.

Wood volume category	**Total (million ft^3)[2]**	**Vol.%**	**Acres (million)**	**% of total ac**
Total volume	4,561 ft^3	100%	2.4 ac	100 %
Vol. by dbh class				
<5" dbh	118	3		
5 to 16" dbh	2,442	54		
> 16" dbh	1,966	43		
Sum	4,526			
Vol. not considered in supply	1,302	28	0.6	26
Total vol. in management areas	3,263	72	1.8	74
Vol. in management areas by dbh class				
<5" dbh	79	2		
5 to 16" dbh	1,394	43		
> 16" dbh	1,764	55		
Sum	3,238			
Volume by management area		**% of total vol.**		**% of total ac**
Community protection	643	14	0.35	15
MSO restricted habitat	504	11	0.24	10
Municipal watersheds	128	3	0.06	3
Aquatic species watersheds	668	15	0.31	13
Wildlands	1,317	30	0.79	33

[1]Total cubic volume estimates for the ponderosa pine type are from a single data layer and volume by diameter class is from three separate data layers. Discrepancies between estimates derived from the total volume layer those summed over diameter classes is a primarily result of lower computation accuracy in the <5" dbh volume layer.
[2]Tree bole cubic foot volume includes the entire length of the tree, with **no** deduction from the main stem for stumps or tops at specified diameter.

Table 11. Wood supply estimates derived from the consensus and majority treatment scenarios as of year 2006[1]. Potential treatments occur in the ponderosa pine type on 41% of the total analysis area acres for the consensus scenario and on 74% of the area for the majority scenario. The majority scenario was applied to all 74% of the area considered for restoration treatments however, 5% was below a minimum amount of basal area and did not have thinning treatments.

Management area	**Consensus scenario**		**Wood supply (ft^3)[2]**	**Acres treated**	**Ave ft^3/ac harvested**
Community protection	70% of area		368,975,519	314,017	1,175
MSO restricted habitat	30% of area		56,832,525	113,076	503
Municipal watersheds	40% of area		37,448,212	34,471	1,086
Aquatic species watersheds	35% of area		189,626,094	187,157	1,013
Wildlands	35% of area		194,426,007	338,486	574
		Sum	847,308,357	987,206	Ave 858

Management zone	**Majority scenario**				
Community protection	74% of area		371,401,419	335,206	1,108
MSO restricted habitat	74% of area		83,647,154	225,773	370
Municipal watersheds	74% of area		47,206,561	58,031	813
Aquatic species watersheds	74% of area		242,247,408	323,531	749
Wildlands	74% of area		270,810,528	718,927	377
		Sum	1,015,313,070	1,661,467	Ave 611

[1]Wood supply estimates are from 2006 data and have not been projected forward with forest growth information. Restoration treatments will be implemented over several years and tree growth will likely contribute additional wood supply than is shown in the figures above.

[2]Tree bole cubic foot volume includes the entire length of the tree, with **no** deduction from the main stem for stumps or tops at specified diameter.

Table 12. Tree bole[1] and crown biomass estimates (green tons) for consensus and majority scenarios for the ponderosa pine type and each landscape management area. Wood supply for tree boles in cubic foot volume units is added for comparison.

Landscape zone	Tot. bole[1] (tons)	Wood supply[1] (ft^3)	Tot. crown[2] (tons)	Total area	Ave bole[3] (tons/ac)	Ave crown[3] (tons/ac)
Consensus scenario						
Community protection	11,713,509	368,975,519	3,479,963	314,017	37.3	11.08
MSO restricted habitat	1,804,207	56,832,525	536,384	113,076	16.0	4.74
Municipal watersheds	1,188,832	37,448,212	355,581	34,471	34.5	10.32
Aquatic species watersheds	6,019,876	189,626,094	1,788,160	187,157	32.2	9.55
Wildlands	6,172,254	194,426,007	1,831,347	338,486	18.2	5.41
Sum	26,898,678	847,308,357	7,991,436	987,206	27.2	8.09
Majority scenario						
Community protection	11,790,521	371,401,419	3,503,137	335,206	35.2	10.45
MSO restricted habitat	2,655,465	83,647,154	789,558	225,773	11.8	3.50
Municipal watersheds	1,498,621	47,206,561	448,773	58,031	25.8	7.73
Aquatic species watersheds	7,690,394	242,247,408	2,284,993	323,531	23.8	7.06
Wildlands	8,597,160	270,810,528	2,550,706	718,927	12.0	3.55
Sum	32,232,161	1,015,313,070	9,577,167	1,661,467	19.4	5.76

[1]Tree bole weight is the cubic foot wood volume converted to green tons using a factor of 0.0315 green tons = 1000 cubic feet. Tree bole cubic foot volume or weight in green tons includes the entire length of the tree with **no** deduction from the main stem for stumps or tops at specified diameter.
[2]Crown weights from restoration byproducts include all tree foliage, limbs and bark from limbs.
[3]Averge tons of bole and crown material per acre for differ between consensus and majority scenarios because the majority scenario covers an additional 34% of the landscape with generally lower pre-treatment basal area.

Table 13. The amount of the analysis area and ponderosa pine type where a desired post-treatment basal area was not met by the majority scenario by removing only small-diameter trees (<16" dbh). Wood volumes reported in the table are from trees >16" dbh. A total of 81% of the area treated in the majority scenario (74% of landscape) showed that sufficient basal area can potentially be harvested from small-diameter trees accounting for 90% of the total volume (917 million ft^3). This analysis assumes 10% and 20% of the basal area is retained from trees in the <5" dbh and 5 -16" dbh classes respectively.

Management area	Acres	% of management area condition not met[1]	% of total area condition not met	Vol. for trees >16" (ft^3)	% of total volume from trees >16"
Community protection	190,870	53.9	10.8	70,964,198	7.0
MSO restricted habitat	7,496	3.2	0.4	787,812	0.1
Municipal watersheds	70,397	27.4	0.9	3,467,404	0.3
Aquatic species watersheds	16,465	21.1	4.0	15,201,905	1.5
Wildlands	46,838	5.9	2.6	7,591,187	0.8
Sum	332,066		18.7	98,012,506	9.7

[1]Desired post-treatment basal area condition is not met by harvesting only trees <16" dbh.

Table 14. Treatment scenarios in the ponderosa pine type summarized by level of treatment on national and non-national USDA Forest Service (USFS) lands.

Land type	Treatment	Total area (acres)	Total volume (ft^3)	Ave ft^3 harvested/ac
USFS lands	Consensus	886,531	742,492,760	838
Non-USFS lands	Consensus	100,578	104,734,206	1,041
USFS lands	Majority	1,541,262	906,795,594	588
Non-USFS lands	Majority	120,013	108,407,979	903

Table 15. Restoration byproducts harvested and removed by White Mountain area (Apache Sitgreaves National Forest) harvesting contractors in year 2006.

Harvesting Contractors	Harvested materials		
	(thousand green tons)	(million ft^3)	(% of total)
Walker Brothers	110.8	3.17	63.6
Tri Star Logging	44.6	1.27	25.6
Nutrioso Logging	12.3	0.35	7.1
Renegy	6.5	0.19	3.7
TOTAL	174.2	4.98	100.0

Table 16. Restoration byproducts utilized by White Mountain area (Apache Sitgreaves National Forest) mills and manufacturers in year 2006. [1]

Mills and Manufacturers	Utilized materials		
	(thousand green tons)	(million ft^3)	(% of total)
Forest Energy (pellets)	95.9	2.74	55.1
Reidhead[2] (lumber)	24.4	0.70	14.0
Renegy (biomass)	9.8	0.28	5.6
Western Renewables[3] (biomass)	14.1	0.40	8.1
Southwest Forest Products[4] (pallets, mulch, cut stock)	13.3	0.38	7.6
Other (post, poles, logs, etc.)	16.7	0.48	9.6
TOTAL	174.2	4.98	100.0

Source: Apache-Sitgreaves NF, Forest Energy, and SW Forest Products

[1] Conversion rate = 3.5 tons per ccf (70lbs/cf).
[2] The 24K tons to Reidhead was distributed between the Eagar lumber mill (21K tons) and the Nutrioso mill (3K tons).
[3] Western Renewable is no longer in business.
[4] Southwest Forest Products is no longer operating in the White Mt. area.

Table 17. Restoration byproducts harvested and removed by Western Mogollon area (Coconino and Kaibab National Forests) harvesting contractors in year 2006.

Harvesting Contractors	**Harvested materials**		
	(thousand green tons)	**(million ft^3)**	**(% of total)**
SW Forest Products	91.0	2.84	57.4
Hurd Brother's Logging	24.1	0.75	15.2
Perkins Timber	15.2	0.48	9.6
Colorado Wood Co.	2.8	0.09	1.8
High Desert Inv. Co.	25.0	0.78	15.8
Other	0.4	0.01	0.2
Total	158.5	4.95	100.0

Table 18. Restoration byproducts utilized by Western Mogollon Area (Coconino and Kaibab National Forests) mills and manufacturers in year 2006.

Mills and Manufacturers	**Utilized materials**		
	(thousand green tons)	**(million ft^3)**	**(% of total)**
SW Forest Products (pallets, mulch, cut stock)	133.5	4.17	84.2
Canyon Fuels (Zellner's Firewood)	25.0	0.78	15.8
	158.5	4.95	100

Source: Coconino and Kaibab NF, and SW Forest Products
Conversion rate = 3.2 tons per ccf (64lbs/cf). Original values provided in CCF.

Table 19. Flow of wood from specific harvesting contractors operating on USDA Forest Service lands processing facilities for the White Mountains and Western Mogollon Plateau in Arizona.

Western Mogollon area (Coconino and Kaibab National Forests), 2006			
Harvest contractor	**Green tons**	**Processing facility**	**Products**
Southwest Forest	91,000	SW Forest Products	Pallets, cut stock, timbers, misc. landscape
Hurd Bros. Logging	24,100	SW Forest Products	Pallets, cut stock, timbers, misc. landscape
Perkins Timber	15,200	SW Forest Products	Pallets, cut stock, timbers, misc. landscape
Colorado Wood Co.	28,000	SW Forest Products	Pallets, cut stock, timbers, misc. landscape
Other	4,000	SW Forest Products	Pallets, cut stock, timbers, misc. landscape
High Desert	25,000	Canyon fuels	Fire wood
White Mountains area (Apache-Sitgreaves National Forest), 2006			
Future Forest (Walker/WMSP)	79,000	First Energy	Pellets
Future Forest (Walker/WMSP)	16,400	Reidhead	Lumber
Future Forest (Walker/WMSP)	14,100	West. Renew.	Biomass
Future Forest (Walker/WMSP)	1,300	Other	Posts, poles, logs etc.
Nutrioso Logging & Renegy	7,400	Reidhead	Lumber
Nutrioso Logging & Renegy	6,500	Renegy	Biomass
Nutrioso Logging & Renegy	4,900	Other	Posts, poles, logs
Tri Star Logging	16,900	Forest energy	Pellets
Tri Star Logging	14,100	Other	-
Tri Star Logging	300	Renegy	Biomass
Tri Star Logging	13,300	SW Forest Products	-

Table 20. Forest growth estimates from 10 and 20 year FVS cycles using FIA plots in the ponderosa pine forest type (n = 327).

Years	Diameter class[1]	Mean growth[2]	SD	Max/Min[1]	Mean mortality[1]	Net growth[1]
1997-2007	All	42.9	17.8	4/125	2.9	40.0
2007-2027	All	44.2	20.8	4/144	5.3	38.9
1997-2007						
	<5" dbh	1.2	6.3	0/28	0.40	0.76
	5 to 16" dbh	16.5	20.6	0/74	1.5	15.0
	>16" dbh	25.0	21.2	0/185	0.39	24.6
2007-2027	<5" dbh	0.18	5.9	0/36	0.15	0.02
	5 to 16" dbh	13.1	17.9	0/69	0.90	12.2
	>16" dbh	26.7	18.9	0/129	0.27	26.4

[1]Tree growth and mortality for diameter classes is what has accumulated during a 10- or 20 year growth period using FVS models. Trees diameter increment sufficient to move a tree to the next larger diameter class after 10 years will be counted as growth in that category. Some tree mortality is unaccounted for in diameter classes between years 2007 and 2027 because of an FVS programming limitation.
[2]Units are in ft^3/ac/yr

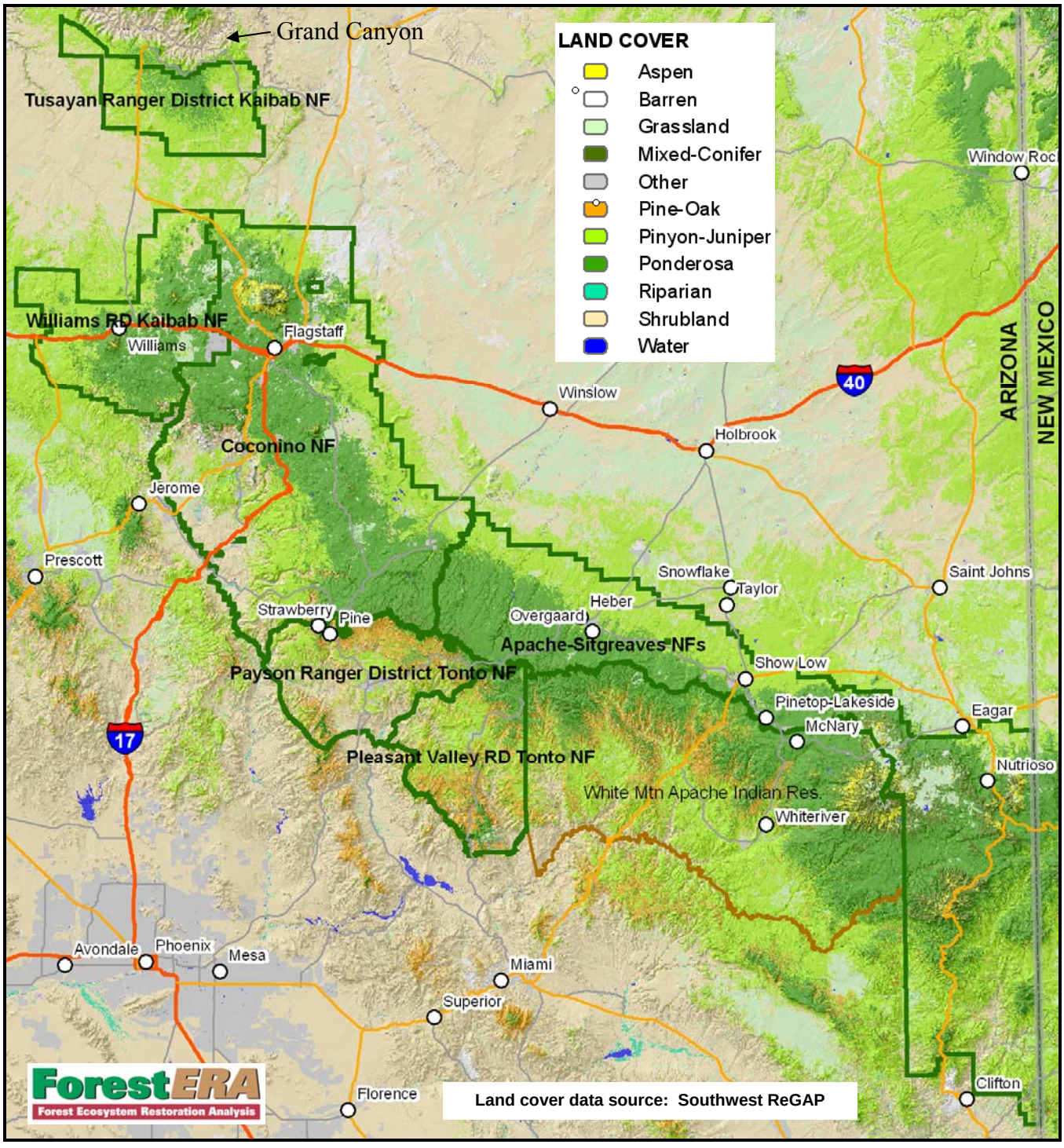

Figure 1. Map detailing the 2.4 million acre wood supply analysis area in northern Arizona. The study area includes ponderosa pine and pine-oak vegetation south of the Grand Canyon and across the Mogollon Plateau to the border of Arizona and New Mexico within the proclamation boundaries of the Kaibab (south of Grand Canyon), Coconino, and Apache-Sitgreaves National Forests, and the Payson and Pleasant Valley Ranger Districts of the Tonto National Forest (outlined in green).

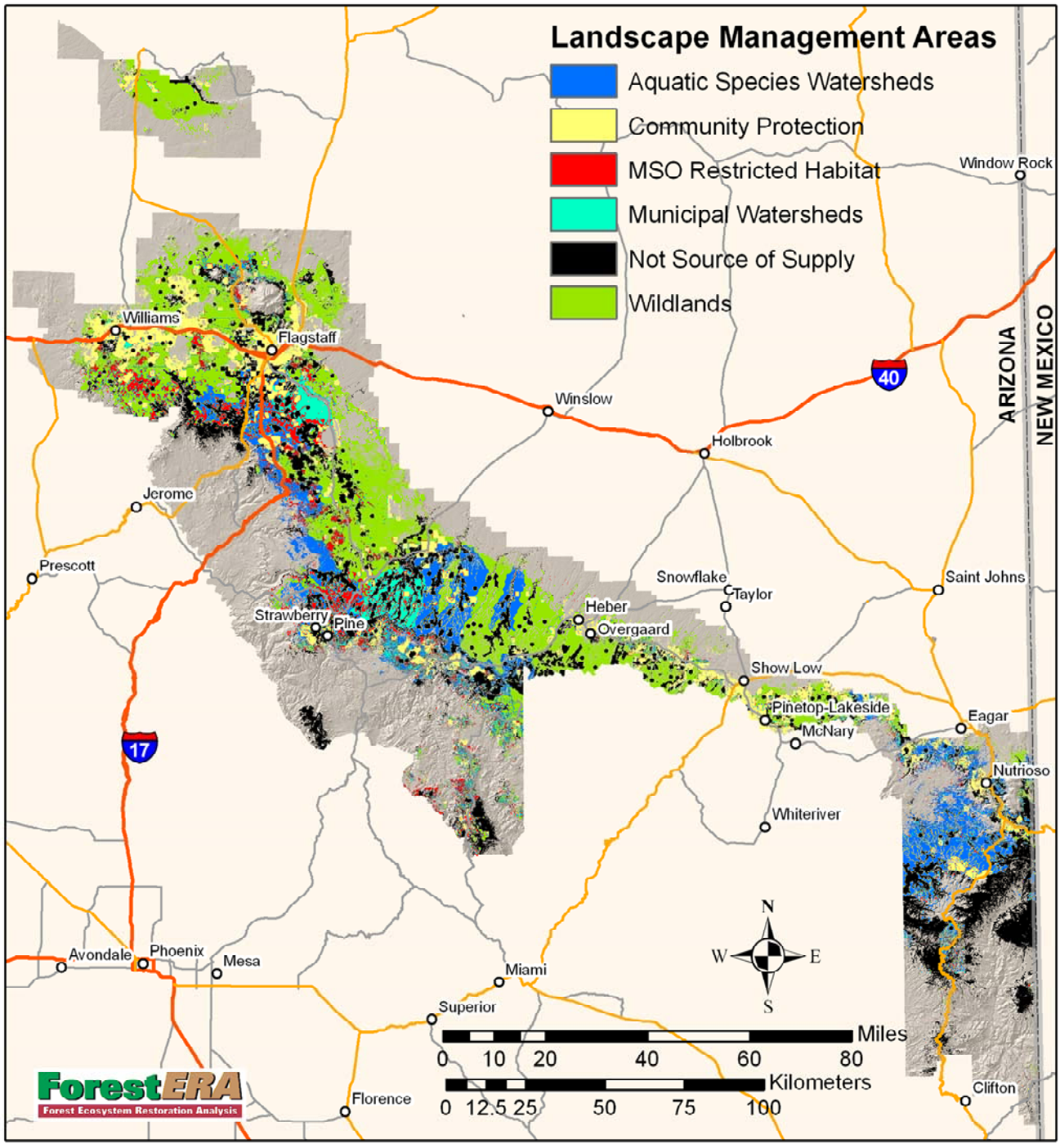

Figure 2. Map depicting areas not considered a source of wood supply from mechanical thinning treatments (black) and landscape management areas (various colors) used to define various desired post-treatment conditions in working group treatment scenarios.

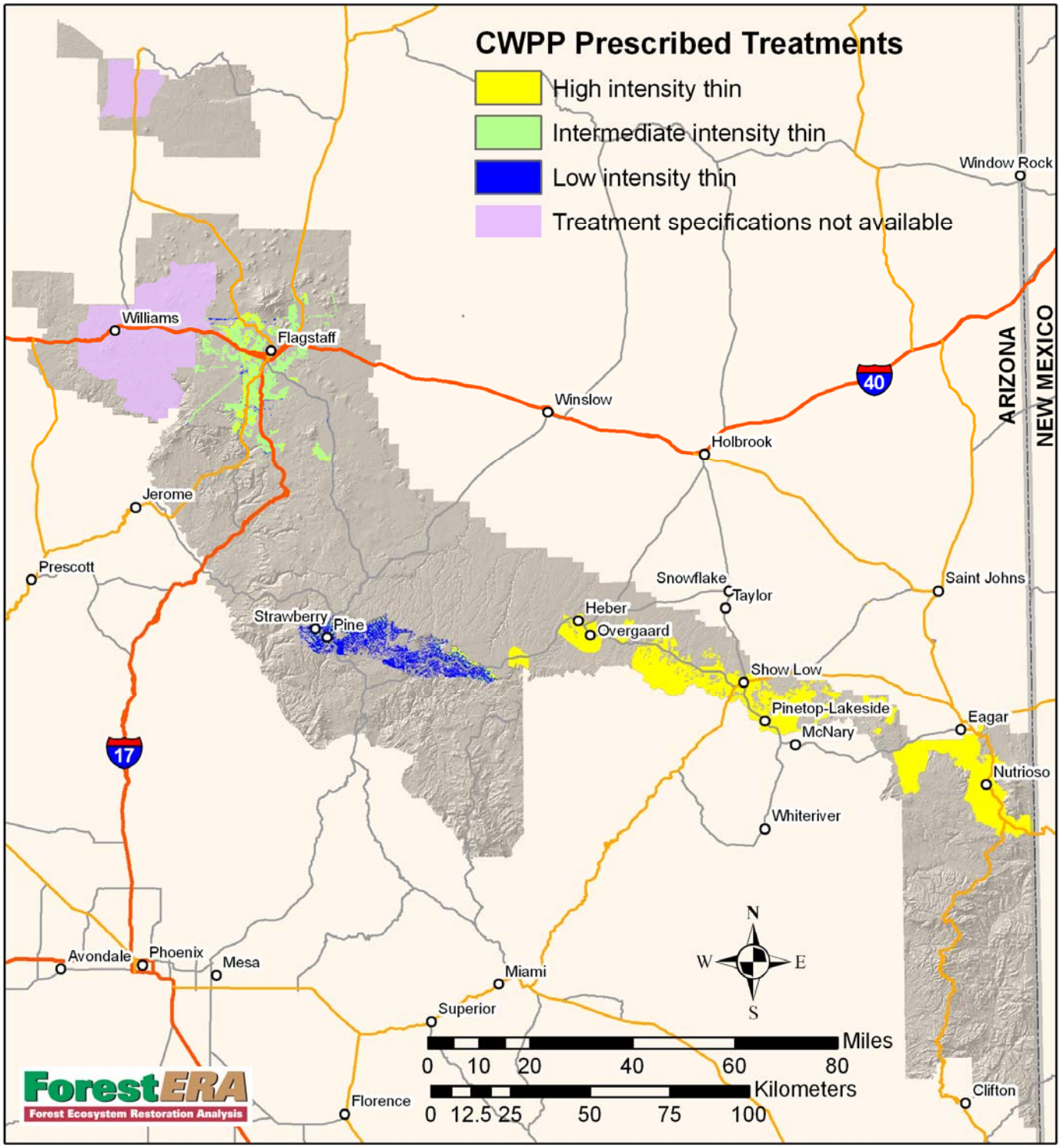

Figure 3. Map of mechanical treatment levels defined in Community Wildfire Protection Plans in the analysis area.

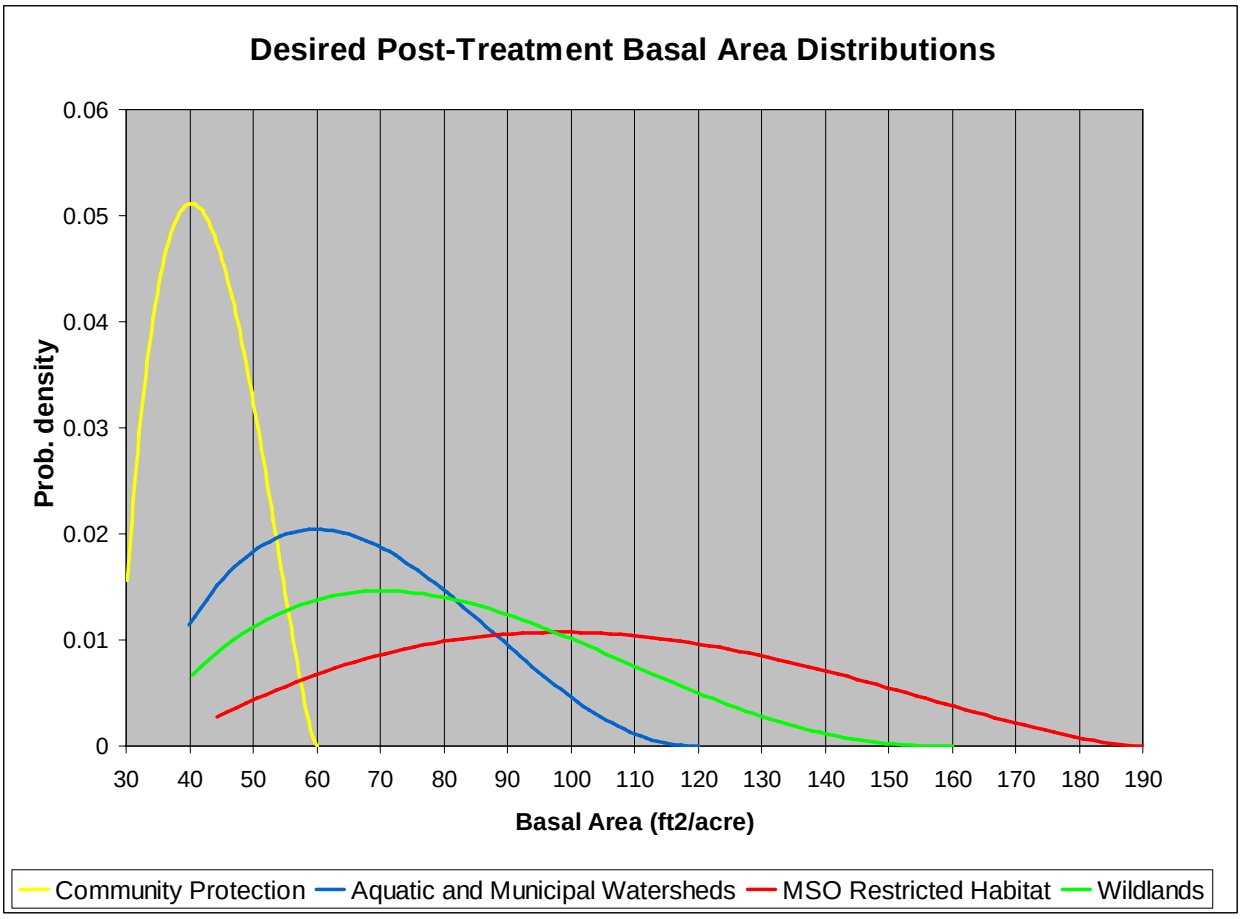

Figure 4. Desired post-treatment ponderosa pine basal area distributions for each landscape management area used in consensus and majority scenarios. Locations with pre-treatment basal areas lower than informed by curves were not decreased following potential treatments.

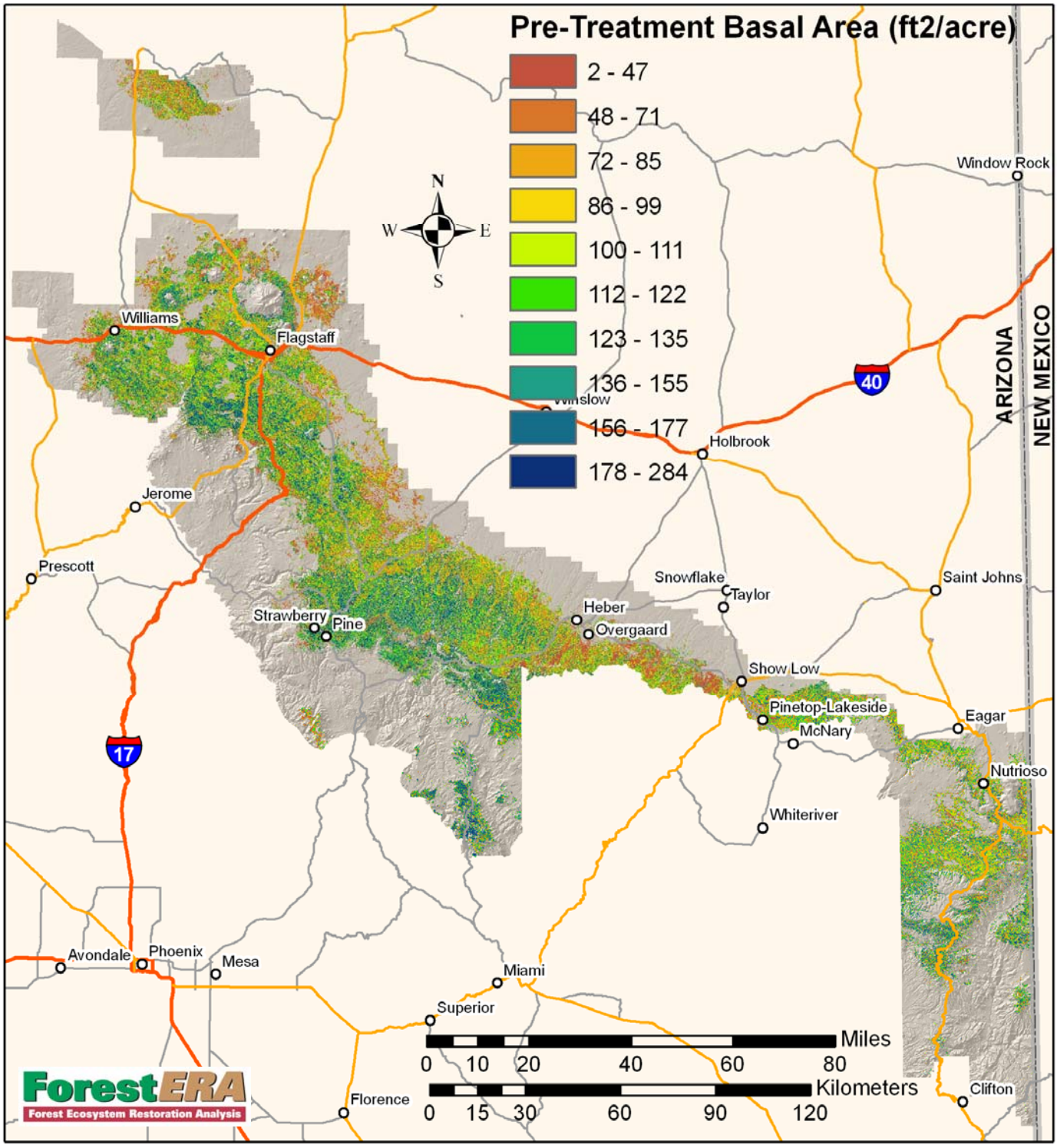

Figure 5. Map of estimated ponderosa pine basal area in year 2006 across the analysis area.

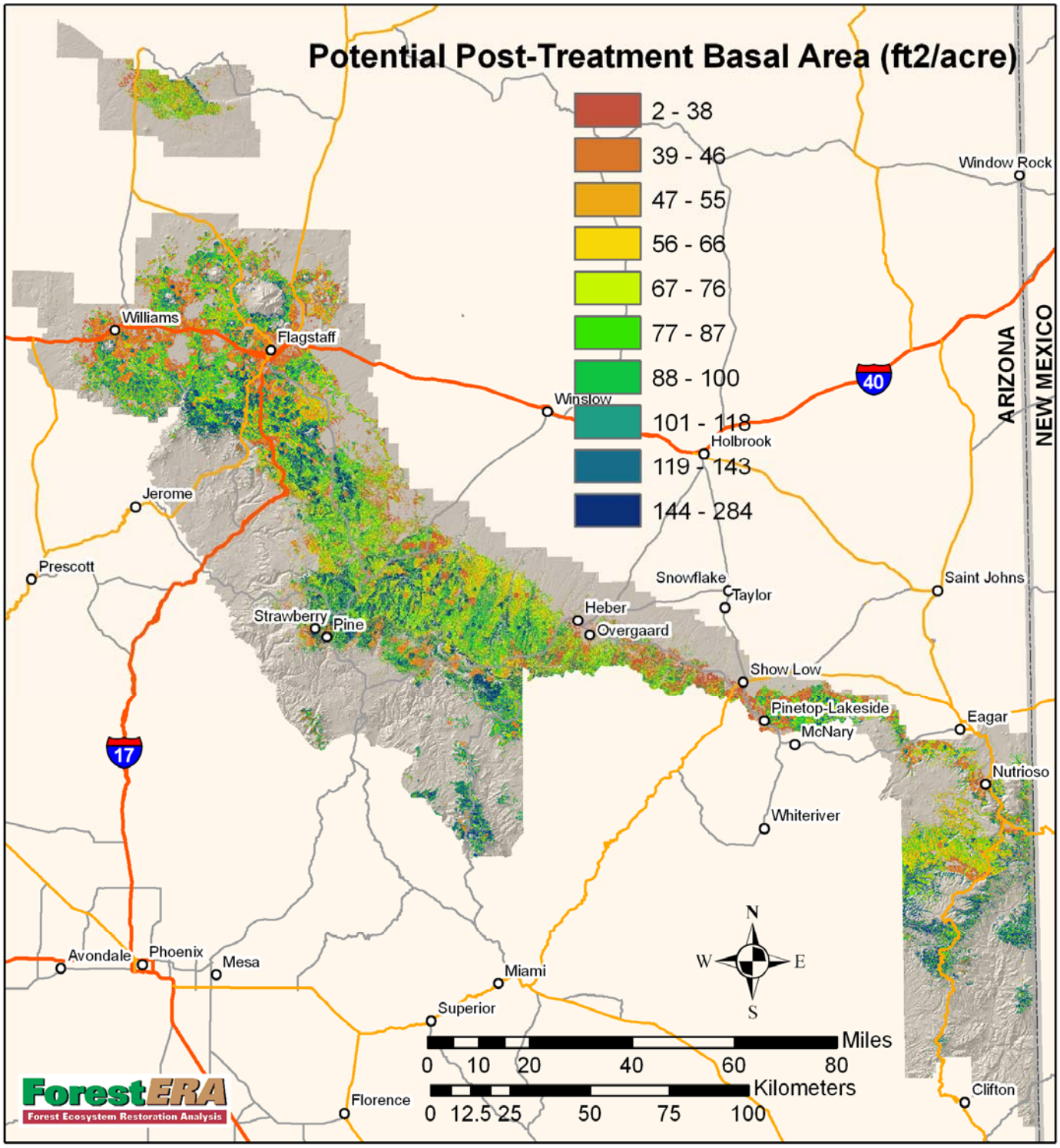

Figure 6. Map of estimated ponderosa pine basal area across the analysis area following potential treatments defined in the majority scenario.

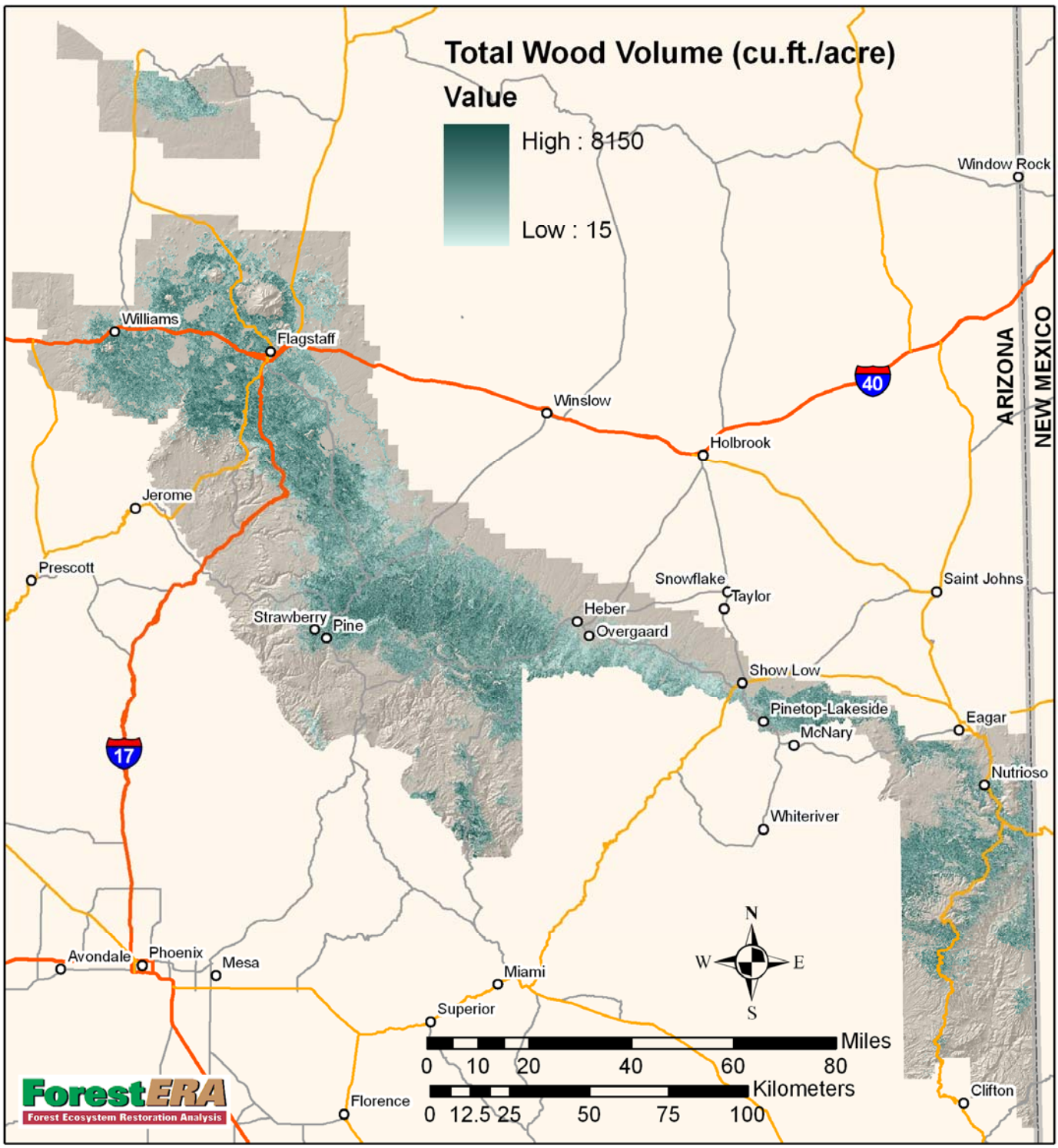

Figure 7. Map of estimated total ponderosa pine bole volume for year 2006 across the wood supply analysis area.

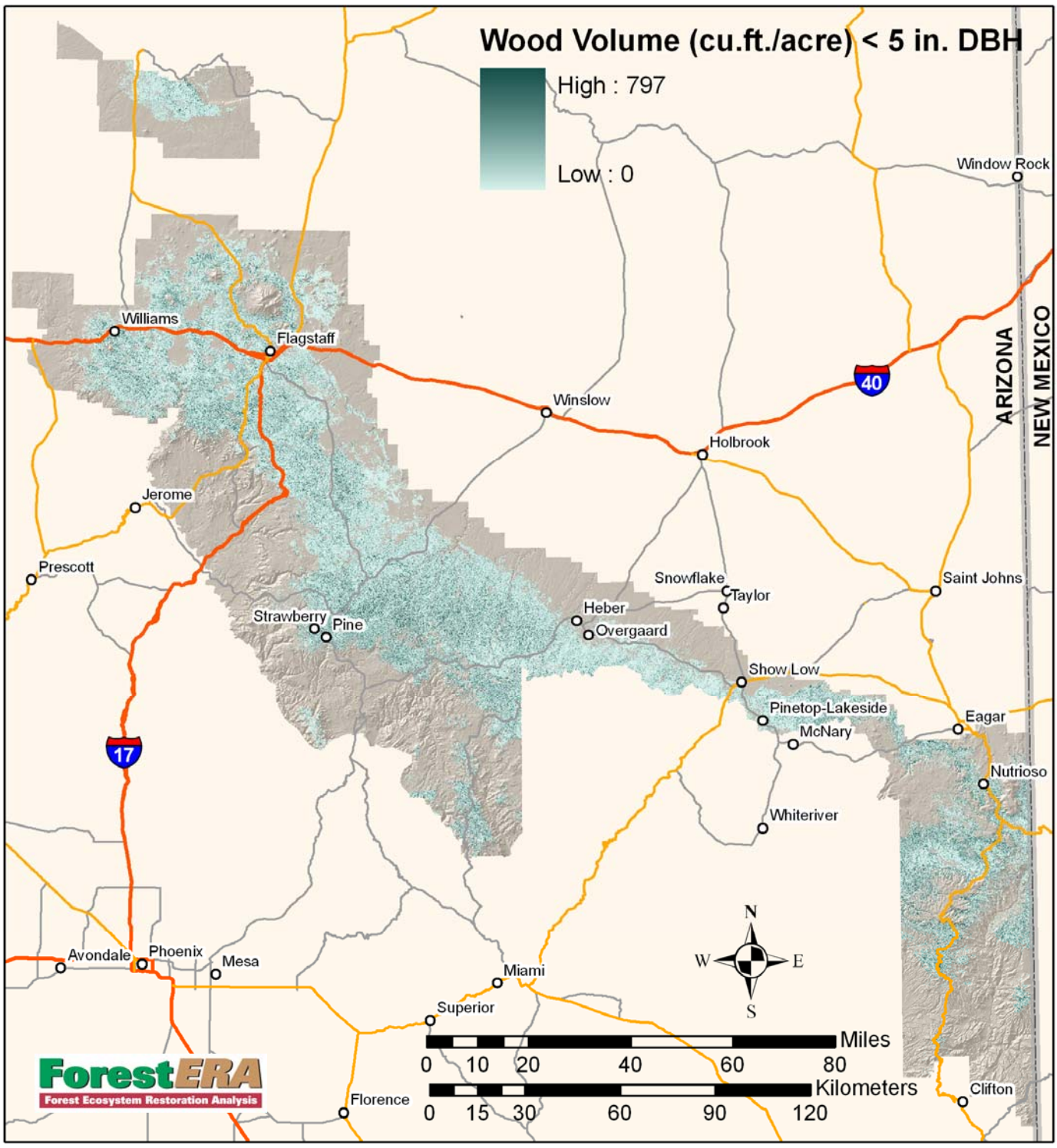

Figure 8. Map of estimated ponderosa pine bole volume for trees <5" dbh for year 2006 across the wood supply analysis area.

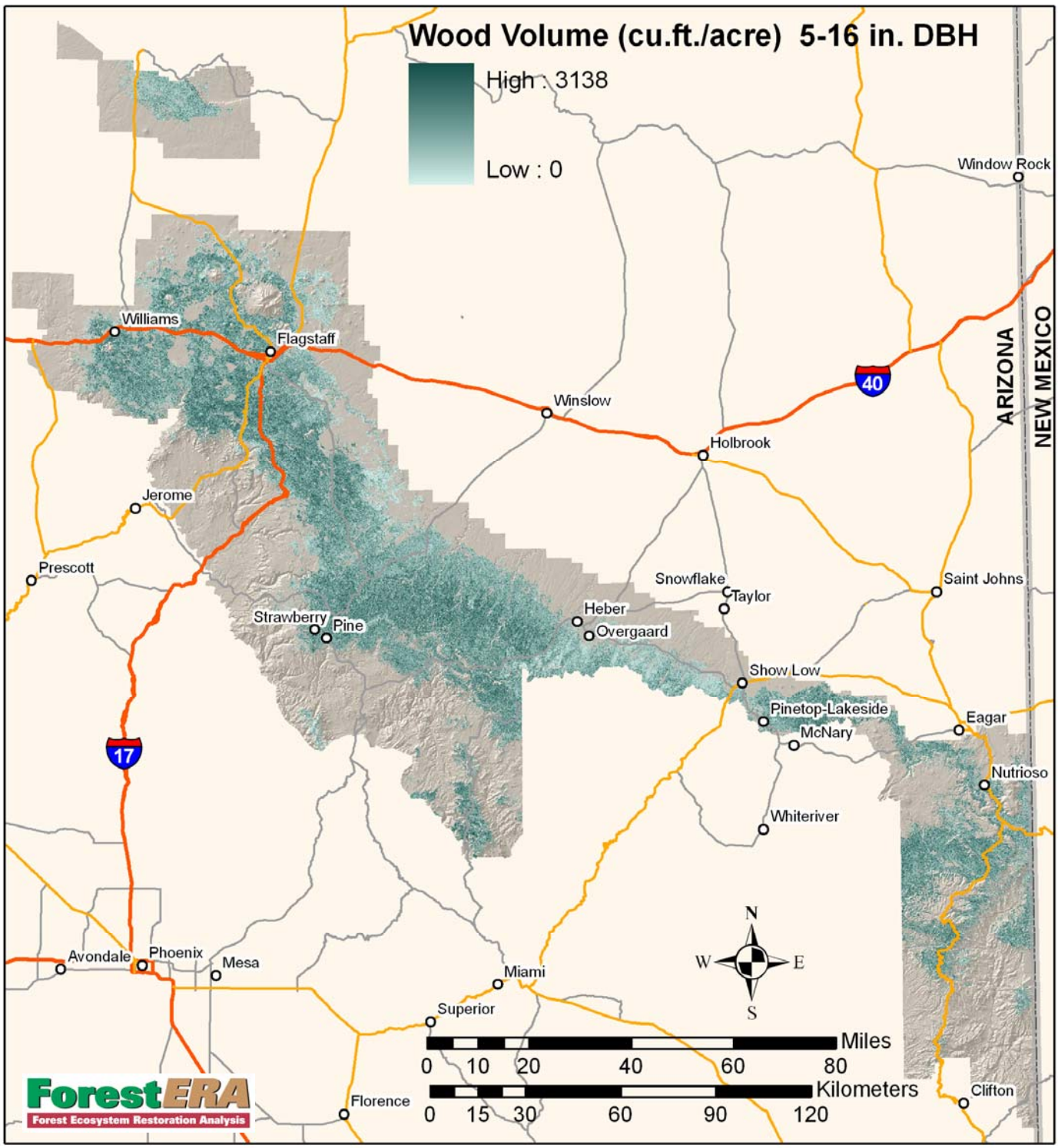

Figure 9. Map of estimated ponderosa pine bole volume for trees ranging from 5 to 16” dbh for year 2006 across the wood supply analysis area.

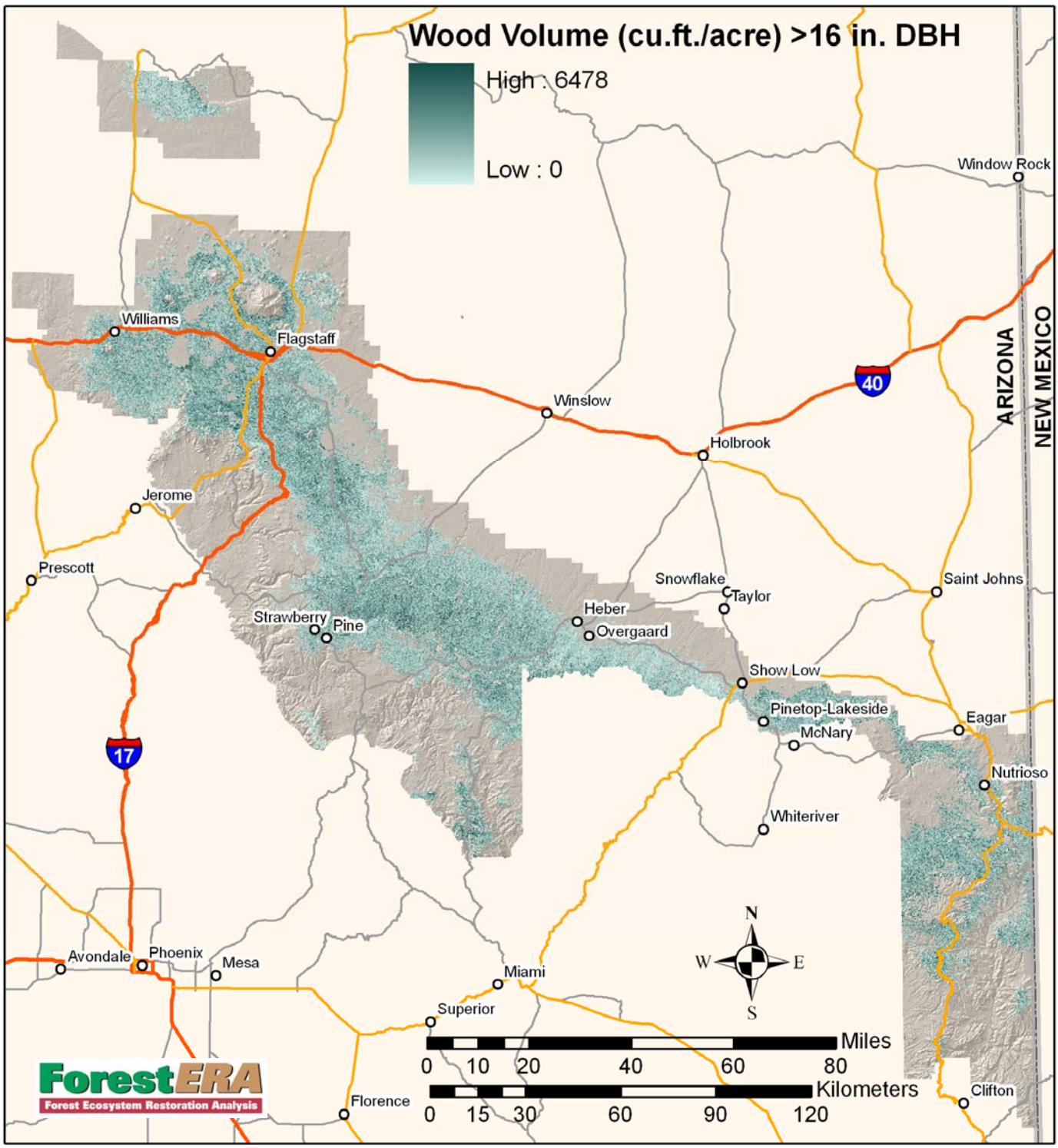

Figure 10. Map of estimated ponderosa pine bole volume for trees >16" dbh in year 2006 across the wood supply analysis area.

Appendices

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Appendix A. Letter from Regional Forester on Utility of Wood Supply Analysis

USDA United States Department of Agriculture
Forest Service
Southwestern Region
Regional Office
333 Broadway SE
Albuquerque, NM 87102
FAX (505) 842-3800
V/TTY (505) 842-3292

File Code: 2400
Date: July 19, 2007

Haydee M. Hampton
Research Associate
Center for Environmental Sciences and Education,
Northern Arizona University
NAU Box 5694
Flagstaff, AZ 86011-5694

Dear Haydee:

We understand that at the first working group meeting for the Arizona Supply Study, the working group asked for some clarification on how the Southwestern Region would use the results of the study.

We believe the study will prove to be a valuable tool in advancing our efforts to restore the functionality of fire adapted ecosystems through treatments that simultaneously improve forest health and reduce the threat of wildfire to communities. Central to accomplishing this work is fostering the development of industries that can capture the economic value of the excess biomass and reduce treatment costs.

The utility of the study is threefold. First, it will provide us a better understanding of the zone of conceptual agreement across the broad spectrum of stakeholders of the range of available biomass resulting as a byproduct of various restoration treatment scenarios. Secondly, it will provide an additional dimension to build on our discussions at the local level as to the scale and scope of restoration treatments. Thirdly, it will assist both us and potential private investors in assessing the appropriate scale of infrastructure development to utilize the biomass produced as a byproduct of restoration projects.

Please share this information with the working group and our encouragement to continue to ask for any additional clarification or information that will further enhance the success of this effort.

Sincerely,

/s/ Abel M. Camarena (for)
HARV FORSGREN
Regional Forester

Appendix B. Wood Supply Working Group Meeting Agendas and Summaries

Wood Supply Working Group
Analysis of Small-Diameter Wood Supply in Northern Arizona

June 4, 2007, Northland Pioneer College, Holbrook, AZ
9:00 a.m. – 4:15 p.m.

9:00 – 9:15 a.m.	**Welcome** - *Tom Sisk* (Professor, Environmental Sciences, Northern Arizona University)
9:15 – 9:30 a.m.	**Agenda Review –** *Haydee Hampton* (Research Associate, Environmental Sciences, Northern Arizona University)
9:30 – 9:45 a.m.	**Group Introductions –** *Rosemary Romero* (Facilitator, Rosemary Romero Consulting)
9:45 – 10:30 a.m.	**Wood Supply Steering Committee presentations –** *Steve Gatewood* (Consultant, Wildwood Consulting and Former Director, Greater Flagstaff Forests Partnership) *Todd Schulke* (Forest Programs Director, Center for Biological Diversity) *Diane Vosick* (Associate Director, Ecological Restoration Institute) *Elaine Zieroth* (Forest Supervisor, Apache-Sitgreaves National Forests) *Rob Davis* (President / Owner, Forest Energy / Future Forests)
10:30 – 10:45 a.m.	Break
10:45 – 12:00 p.m.	**Wood Supply Analysis Goals and Objectives** **Presentation –** *Gilbert Zepeda* (Director of Forestry, Forest Health, Cooperative Forestry, and International Forestry, Southwestern Region, USDA Forest Service) The Region's interest in funding this project and how they intend to use analysis products in decision making (15-20 minutes with Q/A) **Presentation –** *Tom Sisk* Benefits of landscape-scale analyses in general and previous treatment scenario work accomplished during the Western Mogollon Plateau and White Mountains Landscape Assessments (20-30 minutes with Q/A) **Presentation –** *Haydee Hampton* and *Gary Snider* (Forest Economist and Doctoral Candidate, School of Forestry, Northern Arizona University) Description of Wood Supply Analysis objectives, methods, analysis area, and time line (20-30 minutes with Q/A)

12:00 – 1:00 p.m.	Lunch
1:00 – 1:15 p.m.	**Process Review –** *Rosemary Romero*
1:15 – 2:30 p.m.	**Setting the Scene**
	~~**Presentation** – *Herb Hopper* (Community-based Forest and Wood Products Advocate, Little Colorado Plateau Resource, Conservation & Development)~~
	~~Economic Considerations for Restoring Forest Health (15 minutes with Q/A)~~ (cancelled as Mr. Hopper could not attend)
	Presentations – *Shaula Hedwall*; US Fish and Wildlife, *Sarah Lantz*; Urban Wildlife Planner, AZGF, and *Jerry Drury*, Timber Staff Officer, Kaibab National Forest, *Jim Probst,* Hydrologist, Apache-Sitgreaves National Forest
	Treatment-related regulations and guidelines relevant to siting treatments at the landscape scale. What constraints need to be considered when developing treatment scenarios? (15-20 minutes each with Q/A)
2:30 – 2:45 p.m.	Break
2:45 – 3:45 p.m.	**Data needs for developing treatment scenarios –** *Tom Sisk, Haydee Hampton and Jill Rundall*
	Treatment scenario development and data available for analysis area. Facilitated discussion and prioritization on need for and availability of additional spatial data
	Logistics for next meeting
3:45 – 4:15 p.m.	**Public comment period**
4:15 p.m	Adjourn

Meeting Summary
Wood Supply Working Group Kick-Off Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona
June 4, 2007, Northland Pioneer College, Holbrook, Arizona

Introduction and Agenda Review

Tom Sisk: *Welcoming*
Sisk (Professor, Center for Environmental Sciences and Education at Northern Arizona University (NAU)) welcomed members of the Working Group and the public to the kick-off meeting. After mentioning recent and ongoing forest restoration studies wherein a consensus of public opinion had been reached, Sisk encouraged the group to consider ways in which they could take the next step of joining economic development with forest health. The working group draws from the perspectives of numerous organizations, interest groups and industries, and Sisk remarked that this diversity of opinion and interest makes for a radical approach to the forest restoration process in Arizona. In addition to the efforts of those involved, Sisk also stated that the large base of spatial science and research the group has to draw from may better reveal specific areas on the landscape where economic stabilization and forest restoration can exist harmoniously.

Sisk then turned the floor over to Haydee Hampton (Research Associate, Center for Environmental Sciences and Education at NAU), the Forest Ecosystem Restoration Analysis (ForestERA) Project Manager leading this collaborative effort.

Haydee Hampton: *Agenda, contents of workbook, and Wood Supply Team introductions*
Hampton presented the agenda for the kick-off meeting, went over possible dates for upcoming working group meetings, and explained sections of the workbook to those members present. She encouraged Working Group members to review materials included in the workbook. If members wish for information/documents to be included in the workbook for subsequent meetings, let Hampton know. Members requested that reference materials be made available online, and Hampton agreed to make these available on the ForestERA website (http://www.forestera.nau.edu/project_woodsupply_documents.htm). Hampton explained that the Working Group operates using a fishbowl method, meaning that stakeholders not on the Working Group are always welcome to submit comments for consideration both during meetings and between meetings by phone, email or post as detailed on the Wood Supply web pages.

Hampton introduced members of ForestERA's Project Team not present at the Working Group kick-off meeting: Brett Dickson (Ecologist), Yaguang Xu (Spatial Analyst, GIS Developer). She then introduced Jill Rundall, GIS Specialist, ForestERA; Jada Ach, Scribe; Rosemary Romero, Meeting Facilitator; and Gary Snider, Forest Economist and Doctoral student in the School of Forestry at Northern Arizona University.

Rosemary Romero: *Group Introductions*
Romero coordinated Working Group member introductions.

***Working Group members present at meeting (in order of presentation)*:**
1) Scott Higginson, Executive Vice President of NZ Legacy/Snowflake White Mountain Power, Renergy
2) Elaine Zieroth, Forest Supervisor for Apache-Sitgreaves National Forest
3) Diane Vosick, Associate Director of the Ecological Restoration Institute
4) Steve Gatewood, Director of the Greater Flagstaff Forests Partnership
5) Shaula Hedwall, representative of the U.S. Fish and Wildlife Service, Ecological Services
6) Sarah Lantz, Urban Wildlife Planner for Arizona Game and Fish Department (Region II Flagstaff Office)
7) Keith Pajkos, Timber Staff for the Arizona State Lands Department Forestry Division
8) Larry Stephenson, Executive Director of the Eastern Arizona Counties Organization (ECO)/Economic Environmental Counties Organization (EECO)
9) Edward Smith, The Nature Conservancy
10) Kim Newbauer, Representative of Coconino National Forest
11) Jerry Drury, Timber Staff Officer for Kaibab National Forest
12) Pascal Berlioux, President and Chief Executive Officer of Arizona Forest Restoration Products, Inc.
13) Ethan Aumack, Director of Restoration Programs for Grand Canyon Trust
14) Bill Greenwood, City Manager for the Town of Eagar
15) Rob Davis, President/Owner of Forest Energy Corporation/Future Forests
16) Todd Schulke, Forest Programs Director for the Center of Biological Diversity

***Working Group members not present at meeting*:**
1) Robert LaCapa, Forest Manager, DOI BIA Fort Apache Agency Branch of Forestry
2) Chuck Peone, Fort Apache Timber Co.
3) Paul DeClay, Tribal Forester, Forestry Department, White Mountains Apache Tribe

Meeting observers:
1) Jessica Covey, FEC
2) Bob Baltes, BDA
3) Mary Beth Prior, BDA
4) Carol Boyd, Stewardship Staff Officer, Coconino National Forest
5) Paul Ferris, City Planner for City of Winslow
6) Tammy Mazzetti, Grant Forest Products

After introductions, Romero outlined the logistics of the meeting. She stated that it is her role to help move the conversation forward during this public process.

Steering Committee Presentations

Steve Gatewood: *Inception of This Process*

Gatewood spoke of how this collaborative process began and focused on the central question of what forest restoration projects generate in terms of wood supply. Gatewood repeatedly stressed that such a partnership calls for community-based forest restoration and utilization. He asked the Working Group to consider how to generate information that seeks to determine the available supply. He posed several additional questions for consideration, such as the following: What is the available supply? How much is available for utilization? What if the need exceeds the supply of these restoration projects? How will large users affect small users? Before coming to a resolution in this process, these issues need to be considered.

According to Gatewood, another major issue to consider during this process is the long-term product supply, of which he begged the following questions: What happens to growth, and how much of that growth can we rely on in the future? If we are successful at restoring fire-adapted ecosystems, how does that change future wood volumes? In conclusion, this group needs seek out ways of estimating the long-term supply.

In order to come closer to restoring Arizona's forests, this wood supply analysis must move forward so that industries have the information they need to determine supply.

Todd Schulke:

Schulke spoke on the need for a landscape-scale approach to the restoration or Arizona's forests. His two major questions for the group centered on the need for forest restoration efforts to pair successfully with economic development: what are the high priority areas in Arizona in terms of risk, and how will we pay for such work? It is time to merge these ideas of ecological restoration with economics, Schulke said, because paying for such restorative efforts will be critical.

Schulke says that he is confident in a landscape-scale approach to forest restoration. The success of such an approach has already been documented (Signal Peak Assessment Project) which uses LANDFIRE data, further convincing Schulke that such an approach to forest restoration is important.

Schulke also expressed confidence in the collaborative process adopted by this Working Group. The key for making such a collaborative process run smoothly is to find a zone of agreement between the members' diverse goals and interests. In conclusion, Schulke was excited about such a community-based approach to forest restoration that economizes on an economically sound approach to Arizona's ecological needs.

Diane Vosick:

Vosick spoke on obstacles that the Working Group may encounter when trying to develop a feasible restoration plan. The pace and scale of the group's work is not commensurable to the problem, she said, and therefore a better zone of agreement is

needed. She said that Arizona's economy would not survive unless we restore forest health.

Speaking on the economic side of the issue, Vosick stressed that people are a part of the landscape; so much of rural Arizona depends on tourism, water and other environmental services. Coming to a consensus on a restoration plan that runs concurrent with these economic values will be of the utmost importance during this collaborative process. Vosick hopes that this process, along with the Statewide Strategy, will provide lots of momentum for changing Arizona environmental policies. It will be important in the next 6 months, Vosick asserted, to seek out a solution that the entire group agrees is a good solution.

Elaine Zieroth:

Zieroth spoke on the tool of stewardship contracting, which may be an outcome of this process. She provided the group with background information on Stewardship contracting, noting that such contracts are based on authority passed by Congress; the Forest Service and the Bureau of land Management engage in long-term contracts where goods can be traded for services. In sum, under such contracts wood fiber can be traded for work needed on forests (thinning, restoration, etc.). If the wood has more value, the industries can pay for the restoration activities themselves. She added that the value of products alone might now be enough to generate work in some areas, which makes such pairing of restoration with economic development so important.

Zieroth posed several questions for the group to consider in regards to stewardship contracting: What treatment do our forests need? What is left in the forest, and what is the economic value of that? Is entering into a 10-year contract enough to stimulate the industry, or should we be thinking more long-term?

She commented on the success of stewardship contracts, citing the Vincent Fire as an example. This fire recently burned into units thinned under such contracts and went right to the ground; groups were able to put out the fire almost immediately. In addition to fire risks, Zieroth listed drought and climate change as other factors to consider when determining zones for contracting. Markets for smaller material, such as the products of the Apache-Sitgreaves Forest, need to be developed. To do this, we need to pick up the pace, she said, and look for both large industries and community-based industries for support.

Rob Davis:

Davis encouraged the group to consider ways to better utilize forest restoration products. Wood that remains on the ground after such restorative efforts (i.e. thinning) should not be considered waste, Davis argues, but a valuable resource. The value and cost of such a supply needs to be recognized.

There is a need, Davis said, to find people and industries that can pay for such efforts. After seeking out larger consumers to work under larger contracts, money can be put into smaller industries. Davis said that if they can't find industries to pay for restoration

products, then that restoration is not going to happen. While working with this group, Davis feels that the following questions will be necessary to answer if this process is to move forward: What is an appropriate landscape size for such efforts? What can be done in those prescribed areas? What is the available supply? What industries fit our resources economically and volume-wise? What projects will work for the long-term? Only when these economical questions can be answered will there be hope for Arizona's forests, Davis says. We are looking for a policy, Davis says of the group's mission, and if the community and state want to move forward on this then that is the reliability of the supply

Romero summarized questions and ideas remarked upon thus far in presentations: addressing community needs, seeking out an appropriate industry, estimating available supply, and accounting for needs of wildlife. She encouraged the group to untangle this complexity – to think about where members can find a zone of agreement.

Wood Supply Analysis Goals and Objectives – Presentation by Gilbert Zepeda: Zepeda (Director of Forestry, Forest Health, Cooperative Forestry, and International Forestry, Southwestern Region, USDA Forest Service) began his discussion by remarking on what he considered to be the central priority of forest restoration discussions: to restore functionality of fire-adapted forests. We must ground ourselves in that goal, he said, by seeking support across districts and forests.

Much of Zepeda's presentation focused on the efforts of forest restoration projects as they affect WUIs (Wildland Urban Interfaces). Until we are able to reduce the risk of uncharacteristic fires in communities, we're never going to be able to let fire run its natural course across the landscape in an effective way, he said. One possible solution is to perform strategically placed thinning treatments in these areas. With Zepeda citing the original estimate of WUIs at 2 million acres, he stresses the need to assess risk factors in those areas first and foremost. Treatments of WUIs are expensive, however, usually necessitating mechanical treatment. Funding for such efforts is therefore a key question.

The challenge lies between the need to restore 17 million acres of unhealthy forests in Arizona and the costs which would be associated with such a plan, Zepeda said. According to cited figures, to treat WUIs and non-WUIs would cost an estimated 1.5 billion dollars; Zepeda remarked that in no way would we be able to make such a dent without considering creative alternatives.

In an effort to reduce those costs, Zepeda encouraged the Working Group to consider private investment in excess biomass, noting, however, that such investment should be seen not as the end-all goal, but as a by-product of restoration efforts. The goal is to restore fire-adapted ecosystems – not to benefit industries, not economic development. This goal must be achieved at a faster rate and in a larger way.

Zepeda stated that he admires such a collaborative effort between diverse stakeholders and spatial scientists. This broader approach to forest restoration has always been missing

in previous studies and figures, and Zepeda stated that unless there's a collaborative effort in coming up with the necessary gross and net amounts of woody material, this could end up being just another study. All critical players that have a stake in Northern Arizona must have a voice in what comes out of this. In terms of agency capacity, Zepeda mentioned that those supporting restorative efforts for Arizona forests have lost a lot of institutional capacity in the last couple of years; the restoration needs exceed what such groups are capable of working on. If this group comes to a conceptual agreement of what large-scale restoration looks like while considering the support of biomass in a sustainable way, then there will be less of a need to run mechanical treatments. If such solutions are reached in this study, Zepeda believes that support can be garnered at the national level to build institutional capacity for facilitating such efforts.

While fire risk poses one of the largest threats to forest health, Zepeda urged the group to also consider such risk factors as drought and climate change. What are the long term consequences of these elements to forests? Unless we build resiliency in the system to the threat posed by fire, climate change will only exacerbate the current negative state of forest health.

Zepeda remarked that while Stewardship contracting is not an end-all, it is obviously a part of an overall restoration priority. Such contracts can be a tool we can use when appropriate, offering assurances to industries and communities. Zepeda concluded by asking the group to think about the high priority areas throughout this collaborative process. Focusing on key risk areas will lend more structure to restorative investments. When groups fail to look at high priority areas, then they are not employing a landscape-scale approach to the problem of forest health.

Q: Are you looking at applying stewardship contracts in different ways? Setting up a regional stewardship contracting program?

A: This is a business plan the Forest Service considers a central priority, Zepeda said. Do we invest in a lot of small contracts? One large one? On a regional scale? He is looking at it in multiple scales and is concerned that by going with one huge contract, the smaller guy would be aced out. Depending on local needs and type of utilization that's taking place, Zepeda said, there is a need for an array of industries. Zepeda also noted that the Working Group's activities do not satisfy the public process requirements that are initiated when a stewardship contract is officially considered by the Forest Service.

Q: Are the results of this process being institutionalized in any way?

A: Zepeda said that the issue of institutionalization is an ongoing discussion. When the initial proposal came forward, that was a concern. This study will hopefully be a springboard for looking at that zone of agreement across larger audiences. He stated that the Forest Service has no preconceived notions of what would come out of this study, nor is the Forest Service planning to use this information to analyze proposals from any one particular industrial user. At the beginning, the Forest Service questioned whether or not they should be involved in the Working Group dialogue. Zepeda wishes this process to be

a community-based approach without any preconceived notions coming from the Forest Service. Without a zone of agreement and a broad idea of what the available supply is, he doesn't think we can make the gains that we wish to make as a community at-large.

Tom Sisk: *The importance of a landscape-scale perspective in forest treatment planning and a review of previous collaborative landscape assessments in the analysis area (PowerPoint Presentation)*

Before beginning the PowerPoint presentation, Sisk wanted to make his role as a member of ForestERA clear to the Working Group. He stated that his aims are to help this process and to clarify three key elements of this group's aim: the idea of landscape, the collaborative process, and the scientific tools that can be utilized for reaching a consensus on risk areas and supply.

ForestERA uses a landscape-based approach to forest restoration analysis and planning, and in the following PowerPoint presentation (which can be downloaded from the ForestERA site), Sisk wishes to outline the benefits of such an approach. His portion of the presentation delved into how spatial analysis can determine priority areas, how such an analysis can be crafted to benefit the work of the Working Group, and what role Forest ERA can play in providing such an analysis.

Note: Power Point slides from this presentation are available at the Wood Supply Analysis Documents web page at:
http://www.forestera.nau.edu/docs/June04_07_Wood_Supply_Kick-off_Mtn_TDS.pdf

The first few slides defined what it means to approach forest restoration at a landscape scale. Sisk stressed that all analysis and planning should be conducted at scales that capture the key process that shape our forests, and there is therefore a need to conduct the planning and analysis on a larger scale. Such a large scale is able to assess such important determining factors as fire, wildlife habitat, and the utilization of supply. He noted that this group is taking the first swing at this utilization issue, emphasizing the fact that utilization needs to be a piece of the restorative process.

Fire, Sisk noted, is obviously a factor that determines what the landscape is. We just can't determine the precise size of the landscape at risk, Sisk said, but we must instead think of it as dynamic.

Q: For some people it is difficult to grasp what you mean when you say "landscape-scale." It is difficult to communicate that with people because people want something to hold onto specifically.

A: Tom responded to this question by saying that one cannot distill "landscape" into a specific acreage. As a public speaker on this issue, Sisk acknowledged that he must work to try to communicate to the public what, exactly, this means. He insisted, though, that the group must not get away from thinking about this process at a landscape-scale.

An issue for this group, Romero noted, will be how to distill this term and relay it to a broader audience. We must learn to give them enough information so that they may better understand this group's goals.

Sisk responded by saying that since this group is operating in a collaborative way, the goal for understanding what is meant by "landscape-scale" will be to give people the space to define this notion in their own terms.

When presenting the slide titled "Science-Based Public Process," Sisk emphasized the need to identify and prioritize landscape features in critical need of attention. He discussed examples of tools that ForestERA has been developing and noted that in addition to the available science, people play a key role in assessing regions of high risk. Not every place on the landscape has the same risk, Sisk noted, and by involving people in scientific assessments, we can get an idea of where the risk is the highest.

The greatest risk to forest health, Sisk said, is unnatural wildfire, but he also mentioned other notable risks for consideration: insect outbreaks and erosion-prone watersheds. ForestERA has been working on developing ways to rank landscapes according to vulnerability to these factors, in addition to the risk of fire.

Once risk has been assessed using GIS assessment tools, ForestERA can identify treatments on a map as well. Landscape constraints are taken into account, allowing for the determination of appropriate restorative treatments. Sisk says this type of spatial approach to forest restoration collapses traditional one-size fits all approaches, paving the way for healthier forests.

The GIS tools ForestERA has at their disposal can also predict possible effects/outcomes of treatments. Maps are available that show how a specific treatment would change the fire hazard or to reveal how different wildlife habitats could be improved or affected. On the flip-side, there is currently no data to reveal how treatments would affect small-diameter wood supply.

In conclusion, Sisk encouraged the group to feel confident about such a landscape-scale approach to restorative efforts. Even though the Working Group is comprised of stakeholders with different desires, he said, their goals merge in regards to forest restoration projects. Such goals reveal the "sweet spot" where restoration meets economic development.

Q: I thought the objective was not to develop a proposal, but to develop techniques and analysis. Is this the basis of a proposal? A plan to get this amount of wood?

A: Sisk answered by saying that it's not up to him to answer that question due to his technical role in the project. His role is to support the working group. There is no decision mandate. Sisk did say, however, that he hopes that this process will form a foundation for those decisions, but he did not comment further since he sees his role as more of a facilitator than a decision-maker.

Haydee Hampton: *Description of Wood Supply Analysis objectives, methods, analysis area and time line (PowerPoint Presentation)*

Hampton followed Sisk in discussing the scientific basis needed for such restorative efforts. She began by discussing the Wood Supply Analysis goals and objectives included in ForestERA's contract with Region 3, emphasizing the necessity to build agreement on the type and location of forest restoration treatments and estimate the wood supply following collaboratively developed treatment scenarios.

Note: Power Point slides from this presentation are available from the Wood Supply Analysis Documents web page at:
http://www.forestera.nau.edu/docs/June04_2007_WoodSupplyAnalysis_HH_GS.pdf

She also explained that ForestERA will be developing a prediction of the actual area and intensity of treatments versus the area and intensity planned. These factors often differ due to site-specific information not considered in coarser-level planning processes.

Hampton reviewed a map of the Wood Supply Analysis area, emphasizing that the reason we can move forward so quickly in this project (only a 7-month timeline) is that ForestERA has conducted landscape assessments of most of the ponderosa-pine dominated regions in the analysis area. ForestERA has already collected data for and supported two major collaborative processes in the White Mountains and Western Mogollon Plateau. The darker green areas on the basal area map, she noted, denote the presence of ponderosa pine and are the focus of the analysis.

On the slide titled "Build Agreement on the Type and Location," Hampton outlined the logistics involved in such a collaborative process. Hampton explained that the Working Group will meet a total of 6-8 times in Northern Arizona and that the public is always encouraged to attend. Announcements for meetings were sent to about 250 stakeholders. In choosing a location for this meeting, the Wood Supply Steering Committee recommended Holbrook as a good central location located conveniently on an interstate highway. Hampton asked the Working Group for input on locations of future meetings. Some members responded that it was a good central location. Other members thought that meetings should take place in various locations inside analysis area, including Flagstaff and Show Low, so that a greater number of stakeholders could observe.

Hampton then outlined a meeting timetable and explained methods for mapping wood volume layers. ForestERA will be using imputation methods, which link multiple vegetation layers and plot data to common descriptors of vegetation states. Uncertainty estimates will also be provided. Layers used in previous assessments and that will be soon available for the Wood Supply Analysis area from Region 3 include dominant vegetation and cover type, forest canopy cover, and mean tree diameter class.

Hampton then posed the question of which diameter-size ranges would be the most important for the analysis. Is it enough to have 2 DBH classes? Or is it 4 or nothing? She noted there is tradeoff as accuracy will decline as more classes are added, so it's important to assess which classes are most useful and necessary. A member of the Working Group noted the four potential classes shown on Hampton's slide (<5in, 5-9 in, 9-16 in., >16 in. DBH) were fairly standard. Others commented that a 12 in. cutoff, in place of or in addition to a 16 in. break, would also be of interest.

Sisk then responded by saying that ForestERA is breaking new ground in identifying these classes because it is a difficult task to map size-class information. He stated that it is their goal to come up with the best layers for these forests, and this was their first chance to get an initial reaction from the group.

Hampton then delved into how ForestERA develops their vegetation inventory for mapping basal area and other forest structure metrics. She stated that their inventory is based on a stratified random sample and will target under-represented vegetation states in new acquisition. ForestERA is compiling ground plot data from other sources, such as Forest Inventory Analysis (FIA) and Forest Service spatial data, for use in this Analysis and reviewing spatial data from LANDFIRE, Southwest ReGAP, and Region 3 Forest Service.

For more information on the Wood Supply Analysis, Hampton suggested visiting the ForestERA Wood Supply web pages: www.forestera.nau.edu/project_woodsupply.htm. The web pages contain a project summary, meeting information, a list of Working Group members, project updates, a link to a map server and information on how to participate.

Gary Snider:

Gary Snider concluded the presentation (slides 21-23) by discussing existing wood utilizers, framing the issue in terms of supply and demand (for small diameter wood). The demand side of the equation must be considered, Snider noted, meaning we must take wood harvesters, processors, and users into account. Snider will be gathering information on current levels of wood used and existing contracts, as well as capacity, from those on the demand side to include in a database.

Snider mentioned that Arizona forests are currently experiencing a lot of growth, but the question is how much and for how long? Growth affects buying estimates, and in an attempt to begin dissecting these issues for better understanding, Snider said he would put together an annotated bibliography of methods and assumptions, and then make recommendations on best methods. Finally, in order to assess the impact of fine-scaled changes to treatments when they are actually carried out versus planned, he will be reviewing past studies on this issue and interviewing two ID teams from different regions of the study areas.

Gilbert Zepeda:

Following lunch, Zepeda took the floor to share his thoughts about the collaborative process and to clarify for the group how the Forest Service would respond to such dialogue. This study, he remarked, is a result of an unsolicited proposal which can be a source of information to us as we evaluate proposals from wood utilizers. He explained to the Working Group that the Forest Service was not currently soliciting recommendations for restoration plans, so it is a delicate balance as to how this group should engage in this dialogue.

Zepeda asked the group to consider what would be an appropriate means and venue to bring forward recommendations once they reached a consensus. Since the Forest Service funded this study, he stressed that it is important for the group to consider the following question throughout the process: identify what restoration means and what the by-product of those efforts would be in terms of amounts. He further went on to say that the Forest Service will use the information generated from this study as a source of information born from the most contemporary science we have available which is set in a framework that represents a zone of agreement.

Q: Do you see us as making recommendations?

A: This group is not being paid to do a study, Zepeda answered. The information that results in this process will be a tool for the Forest Service to consider, but since the Working Group was not paid by the Forest Service to conduct such a study, FS is not obliged to implement the group's recommendations.

Q: Would getting something in writing help if we wish to later solicit the Forest Service to consider our recommendations? Could a letter or notes from meeting, etc. save time?

A: Sure, Zepeda answered. We could work on drafting a letter with Harv's consent.

Setting the Scene

Shaula Hedwall:

Hedwall, representative from the Fish and Wildlife Service, talked on the issue of wildlife considerations for a regional wood supply analysis. Along with Sarah Lantz from Arizona Game and Fish, she presented a Power Point presentation (which can be viewed on the Wood Supply Analysis documents web page) which delved into how wildlife considerations should be taken into account in this analysis. Her main question was this: how can we incorporate wildlife issues into these treatment plans?

The outline of Hedwall and Lantz's presentation is as follows: USFWS and AGFD Missions, laws and guidance, wildlife/forest treatment goals, and wildlife considerations for forest treatments. Hedwall and Lantz noted that the missions of their respective agencies are quite similar: to provide leadership for sustaining fish and wildlife across the board, not just endangered species.

Hedwall outlined several applicable laws and guidelines that both organizations use as a means of protecting wildlife, including the Endangered Species Act, the Bald and Golden Eagle Protections Act, and the Migratory Bird Treaty Act. Both Hedwall and Lantz stated that while there is no Forest Practices Act in the state of Arizona, both agencies still highly recommend the conservation of species' habitats.

Hedwall concluded her segment of the presentation by saying that FWS works hard to maintain, enhance, and restore habitats. They take a very comprehensive look at the habitat for multiple species' needs in these areas. She feels that the Working Group can fulfill both the supply goals and these FWS goals in creative ways. She encourages the group to consider the effects of widespread analysis and treatment on multiple habitats.

Sarah Lantz:

Lantz continued the PowerPoint presentation by encouraging the Working Group to take a multi-species approach to the question of forest restoration during this process. She proposes a mosaic approach when this group begins implementing treatments. According to Lantz, a mosaic approach would simulate a pattern that most closely resembles the diversity of habitats and wildlife needs.

Regarding the placement of treatments, Lantz listed several key habitat areas where treatments should not take place when considering the needs of wildlife: riparian corridors, canyon rims, steep slopes, north-facing slopes, seeps, springs, tanks, known movement corridors, and known nest sites.

Lantz asked the Working Group to think about what they considered to be the definition of WUIs. Such definitions mean a lot for wildlife as many species live and thrive in such areas. Restoration projects must take that into account before implementing treatment plans in those areas. While Lantz and Hedwall agree that strategic placement of treatments in WUIs is important for this group, they stress that the group must also consider wildlife habitats on equal grounds with other factors such as restoration, economics, and small diameter wood supply.

Q: How do you envision bringing your perspectives into this process?

A: Lantz responded by promoting a mosaic approach to restoration where different treatments would be implemented next to each other. Implementing treatments at different times and assessing species' responses to restoration treatments are other ways that wildlife considerations could be taken into account. Hedwall added that treatments should be modified to account for wildlife habitat.

Participants engaged in the ongoing dialogue by saying that there are two obvious places where the concerns of these wildlife agencies can enter the process. What places in the landscapes could be designed for wildlife? Can we design new types of treatments to fit wildlife needs? Lantz emphasized that she does not want the group to consider wildlife as a constraint to treatments but as a part of what the picture has to look like. Hedwall

remarked that the group should also consider how wildlife will be affected by specific treatments. Participants also remarked that there are prescriptions that can be placed in the WUI that provide for the needs of both wildlife habitats and healthy forest stand structure.

Jim Probst:

Probst (Hydrologist, Apache-Sitgreaves National Forest) encouraged the group to consider the effects of restoration and treatment efforts on soils and watersheds. In terms of watersheds, he addressed two main concerns: high erosion hazards on steep slopes that account for 33% of the project area, and matters of soil sensitivity when determining where to implement treatments.

Probst's advice for large-scale treatment implementation is to avoid restorative efforts during the wet harvest and to consider the impact of roads, landings and skid trails on the landscape, especially near watershed areas.

In conclusion, Probst hopes the Working Group will consider distance from private land, slope gradation, water proximity, and erosion hazards when assessing areas where treatments may be necessary.

Data needs for developing treatment scenarios: Tom Sisk began by discussing the timeline involved in gathering necessary data for reaching a consensus regarding wood supply and restoration needs. Previous analyses have looked at this entire area, he noted, which makes it possible for ForestERA to merge data into products that will be useful for this Working Group. He reminds the group that they are not starting from scratch in terms of research. A goal for the group, he said, will be to prioritize layers of spatial data. Layers available for analysis include basal area, stand density, canopy cover, and wildlife habitat.

His second slide outlined how wildlife habitat can focus efforts. A landscape-level analysis can result in strategizing how species-specific information can be utilized to focus restoration efforts. Sisk cited spatial research regarding the spotted owl and goshawks, illustrating how the Working Group could develop treatment scenarios to minimize the effect of treatments on wildlife.

Haydee Hampton: Hampton stressed that many GIS layers are available for this project, and data is already available for the Working Group to consider. Using spatial data made available to the group in the work book, Hampton reviewed several layers for this region of focus.

Some members of the group were concerned with the presentation of such data of which they have no technical expertise. They remarked that due to their lack of knowledge in the arena of spatial data, they were hesitant to participate in that aspect of the conversation. Sisk reassured the group that the presentation of this data is merely to inform them of what's available and that the goal of ForestERA is to get the group to the level where they can understand such data.

Hampton ended her presentation by informing the group that their spatial data will soon be available online due to a grant received by NAU's Geospatial Research and Information Laboratory (GRAIL). ForestERA will provide groups with various layers as they are created throughout the period of the meetings.

Wrap-Up Discussion (facilitated by Romero):
One group member found the phrase "type and location" to be too vague in the goal: "Build agreement on the type and location of forest restoration treatments". He went on to say that if the group cannot agree upon the operable acreage, then they were never going to find the total potential as a resource. On this point, another participant stated that treatments are linked to acreage – the approach ForestERA is proposing seems to include both the treatment approach and a number of acreage approach – from a methodology perspective he didn't see any disconnect between ForestERA's proposal and those who want a specific acreage amount.

Several members of the Working Group stated that it would be helpful to add more detail to the goal: "Build agreement on the type and location of forest restoration treatments." One participant reminded the group that the central priority is to restore fire adapted ecosystems, and that any estimate of wood supply available for industry use should be based on restoration by-products. She suggested the following steps as part of an iterative process to reach this goal:

1. Identify acres available and appropriate for restoration
2. Identify the restoration goals for those acres
3. Prioritize and assign treatments by size and location to reach the restoration goals
4. Estimate the volume of supply of those acres given these treatments.

Consensus would need to be reached at each step in this process.

The observation was made that these steps were the same as what ForestERA presented. Another participant suggested a similar plan:

1. Identify specific areas that are available and appropriate for restoration
2. Build agreement on forest restoration types for various locations
3. Develop a spatial layer that captures this information.

One participant recommended that we should only consider mechanical treatment in this study. Another countered that we need to consider what happens to areas without mechanical treatments as these will either have Wildland Fire Use or prescribed burning and that this information will be important in placing treatments strategically at the landscape scale.

One participant proposed working through multiple scenarios instead of attempting to arrive at just one scenario that the Forest Service would then have to work with. Some members of the Working Group felt uncomfortable with taking out the phrase "building agreement." One scenario has much more weight than multiple scenarios, they stated, and the group should not begin watering down that goal before even entering the process. Another member stated that the group needs to examine multiple scenarios – not a one-size-fits-all recipe, but a way of assessing problem areas and problem solutions. Sisk responded by saying that arriving at a consensus is the most powerful way to build agreement. The goal of the group is to try to find the sweet spot

upon which they can build agreement. Another Working Group member stated that this is a process, not a restoration plan. Ultimately the need of this group is to develop a map of at-risk places and general treatment plans for those places. "Treatment" was defined as an action that would happen in a specific place. "Treatment Scenario" was defined as consisting of multiple treatments of various types across an analysis area.

A member of the Working Group suggested that the group adopt a filter which would assess how much acreage is available for treatment. There is a need to narrow it down to something more practical, she said, because treatment types are tools. Another group member agreed that acreage and treatment need to go together. He suggested that the group go through each area and progress accordingly with each layer to determine availability. A member of the group expressed concern with such a desire for specificity of acreage and supply. Stakeholders who want certainty want it for political or economic reasons, he said. They want to go to their investors with those figures.

One member of the group stated that this analysis is already tied to a specific purpose, linked to a commissioned study – concerned with an issue of process – fulfill purpose of the study first and foremost – should be acknowledgement, we're only looking at step 1. People from industry need to know right away so they can go out and start working with this supply information. ForestERA staff emphasized that they must deliver an estimate of wood supply under one or more scenarios – hard for us to give estimation on supply without a scenario – we aren't trying to say how much should be taken out, but it involves the goal of restoring the forests – the supply is a by-product of the restoration. Another participant stressed that the focus should be on mechanized treatments, however another reasoned that all types of treatments should be considered. Another participant asked what's going to happen to the acres that aren't treated? Recognizing the reality that fire will play out one way or another will influence treatments.

Public Comments
A stakeholder observing the meeting encouraged the group to be more specific in regards to the goals and objectives. There need to be specific ways to tackle those goals and objectives.

Meeting Locations: Haydee Hampton noted that half the group was closer to Flagstaff while most of the remaining participants were in the White Mountains regions. The group thought the Holbrook location worked well, but hoped that other meetings could be held in Flagstaff and other parts of project area, perhaps Show Low. ForestERA will work on organizing the location in order to accommodate as many people as possible; keeping in mind that the Holbrook location will not be available for the next meeting. The dates of the meetings were organized as follows with locations TBD:

- Wednesday, July 18
- Friday, August 17
- Monday, September 17
- Tuesday, October 9
- Monday, October 15
- Monday, October 29
- Friday, November 16

Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona

July 18, 2007, Arizona Game and Fish Department, Pinetop, AZ
9:00 a.m. – 4:00 p.m.

9:00 – 9:15 a.m.	**Welcome** – *Rosemary Romero* (Facilitator, Rosemary Romero Consulting)
9:15 – 9:30 a.m.	**Agenda Review –** *Haydee Hampton* (Research Associate, Environmental Sciences, Northern Arizona University)
9:30 – 9:45 a.m.	**Group Decision-Making Process –** *Rosemary Romero*
	Treatment Scenario Development
9:45 – 10:30 a.m.	Review: 1) stakeholder questions and comments submitted after June 4 Working Group meeting, 2) how other collaborative groups have built scenarios in previous landscape assessments 3) Working Group suggestions on building treatment scenarios **–** *Haydee Hampton* Treatment characterizations and strategically placed treatments**–** *Brett Dickson*
10:30 – 10:45 a.m.	Break
10:45 – 12:00 p.m.	Suggested ways to account for treatment-related guidelines and regulations relevant to siting treatments at the landscape scale ▪ Guidelines regarding wildlife and wildland urban interface (WUI) **–** *Brett Dickson* (Assistant Research Professor, NAU) ▪ Guidelines regarding streams, soils, access, and mechanized equipment **–** *Haydee Hampton*
12:00 – 1:00 p.m.	Lunch

1:00 – 2:30 p.m. Factors important to identifying areas appropriate for restoration for the Wood Supply Analysis

- Vegetation types, Wilderness Areas and other primary factors *Jill Rundall* (Senior Research Specialist, NAU)
- Working Group brainstorming session to develop a list of on additional factors to consider in identifying areas appropriate for restoration **–** *facilitated by Rosemary Romero*
- Discussion of available spatial data representing priority factors **–** *Brett, Jill, Haydee and Working Group members*

2:30 – 2:45 p.m. Break

2:45 – 3:30 p.m. Optional Working Group Session (if time allows)

- Brainstorming session on restoration objectives for areas available and appropriate for restoration **–** *facilitated by Rosemary Romero*
- Discussion of ways to address restoration objectives in the Working Group's treatment scenario **–** *all*

3:30 – 3:45 p.m. **Updates on Wood Estimation Analyses**

- Wood utilizer database, ponderosa pine growth models, and actual acres/volume following planned treatments **–** *Gary Snider* (Forest Economist and Doctoral Candidate, School of Forestry, Northern Arizona University)
- Wood volume layer by tree-diameter class **–** *Haydee Hampton*

Logistics for next meeting

3:45 – 4:00 p.m. **Public Comment Period**

4:00 p.m. Adjourn

Meeting Summary
Wood Supply Working Group Meeting #2
Analysis of Small-Diameter Wood Supply in Northern Arizona
July 18, 2007, AZ Game and Fish Dept., Pinetop Regional Office, Pinetop, Arizona

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Introduction and Agenda Review

Rosemary Romero: *Welcome*
Romero (Meeting Facilitator) welcomed back the working group members and observers to the second of eight scheduled meetings (2 meetings may be cancelled if sufficient progress is made). She made several brief announcements concerning the meeting and had the working group and audience members introduce themselves.

***Working Group members present at meeting (in order of presentation)*:**
1) Scott Higginson, Executive Vice President of NZ Legacy/Snowflake White Mountain Power, Renergy
2) Shaula Hedwall, representative of the U.S. Fish and Wildlife Service, Ecological Services
3) Sarah Lantz, Urban Wildlife Planner for Arizona Game and Fish Department (Region II Flagstaff Office)
4) Molly Pitts, advocate for Northern Arizona Wood Products Association
5) Elaine Zieroth, Forest Supervisor for Apache-Sitgreaves National Forests
6) Lisa McNeilly, Director of the Northern Arizona Program for The Nature Conservancy
7) Bill Greenwood, City Manager for the Town of Eagar
8) Pascal Berlioux, President and Chief Executive Officer of Arizona Forest Restoration Products, Inc.
9) Rob Davis, President/Owner of Forest Energy Corporation/Future Forests
10) Jerry Drury, Timber Staff Officer for Kaibab National Forest
11) Herb Hopper, Advocate for Little Colorado Plateau Resource Conservation & Development
12) Diane Vosick, Associate Director of the Ecological Restoration Institute
13) Todd Schulke, Forest Programs Director for the Center of Biological Diversity
14) Chuck Peone, Fort Apache Timber Co.
15) Keith Pajkos, Timber Staff for the Arizona State Lands Department Forestry Division
16) Mary Stuever, Forestry Department, White Mountain Apache Tribe (alternate for Paul DeClay, Tribal Forester)

***Working Group members not present at meeting*:**
1) Robert LaCapa, Forest Manager, DOI BIA Fort Apache Agency Branch of Forestry
2) Steve Gatewood, Director of the Greater Flagstaff Forests Partnership
3) Larry Stephenson, Executive Director of the Eastern Arizona Counties Organization (ECO)/Economic Environmental Counties Organization (EECO)
4) Kim Newbauer, Representative of Coconino National Forest
5) Ethan Aumack, Director of Restoration Programs for Grand Canyon Trust

Meeting observers:
1) Penny Pew, Representative for Congressman Renzi
2) Bob Baltes, BDA
3) Greg Morion, USDA - FS
4) Scott Lockhard, USDA - FS
5) Stacey Hamburg, Sierra Club
6) Ed Martin, SFP
7) Sue Sitko, TNC
8) Dwayne Walker, Future Forest

Romero then turned the floor over to Haydee Hampton (Research Associate, Center for Environmental Sciences and Education at Northern Arizona University (NAU)), the Forest Ecosystem Restoration Analysis (ForestERA) Project Manager leading this collaborative effort.

Haydee Hampton: W*ood Supply Team Introductions and Agenda*
Hampton began by introducing new members of ForestERA's Project Team since the last Working Group meeting: Tony Becker, Scribe (PhD student in Linguistics at NAU) and Steve Sesnie, Remote Sensing Specialist (Post-doctoral Research Associate). Sesnie will begin attending Working Group meetings in August.

Hampton provided an overview of the agenda and briefly discussed the highlights for the day's meeting, including three points related to treatment scenario development. Furthermore, Hampton included an overview of the scheduled individual presentations about different treatment scenarios conducted in the past. She encouraged working group members to thoughtfully consider the treatment options presented and provide contributions to the treatment scenarios. Once the agenda was covered, "clickers" were distributed to working group members and Hampton provided a brief PowerPoint presentation to inform members on how to use the clickers, as well as a description of their function. Hampton explained that, if agreed upon, the clickers would be used by the working group to gauge agreement on decisions requiring consensus. The clicker technology will primarily be utilized for group members to indicate their level of agreement on certain issues covered throughout future meetings.

Rosemary Romero: *Group Decision-Making Process*
Romero reviewed a slide ("What leaders can do") that covered some characteristics of leadership and she explained how she envisioned the session would proceed. She encouraged participation from working group members, and explained that the use of clickers would enable rather quiet individuals to participate along-side those who are outspoken. Romero continued by explaining that the clickers were "an anonymous tool to gauge the level of agreement", and should prove effective to promote additional discussion.

In terms of the proposed group decision-making process, Romero commented that the ForestERA group is bringing data and analyses to inform group members, and she encouraged group members to propose ideas and add to the discussion until agreement is reached. She also encouraged group members to work towards an understanding on the issues related to treatment options, rather than simply stating disagreement. She explained that there is never 100 percent

agreement, but she hoped that this process would promote bargaining and eventually lead to language resulting in agreement among working group members.

Afterwards, several statements were presented to the working group members via PowerPoint presentation, in which they were asked to use the clickers to vote. Statement #1 – "The wood supply working group should use the consensus-based decision process described." The results were that five working group members strongly agreed, while five others agreed. At this point, one group member interjected and asked about formatting the voting process – "Can we have time to discuss the matters before we go straight to using the clickers?" Romero responded that this was a baseline question, used to familiarize group members with the technology and voting format. She and Hampton added that dialogue could either follow or precede the actual voting, so that people could express their concerns.

Then, statement #2 was presented – "The wood supply working group should use an online discussion forum." The results were not compiled via the clicker program, but instead were discussed as a group. A discussion of the online forum revealed that some members were opposed to the online forum, since they preferred small or large group discussions compared to the online forum. Another member was concerned that not everyone could participate online because of various reasons, such as time availability and access issues. Another member commented that the online system did not reflect the *fish bowl* process of discussion because it promotes debates that are not in the public forum. He felt that it was rather isolated.

Romero informed the group that the email discussions could work, especially to facilitate small group work. Large group discussions should be reserved for face-to-face meetings, where ideas could be more effectively discussed. The group came to an agreement that informal email discussions, and not a more organized on-line discussion forum, would be maintained as a tool for sharing ideas, but the majority of larger issues would be reserved for large-group meetings.

Lastly, statement #3 was presented – "The June 4th meeting summary is an adequate record of the meeting." The results were that most members strongly agreed or agreed, but several members did not vote, since they had not read the summary. At that time, Romero explained the nature of the summary as "a neutral document that enables people to recall what happened, as well as to reflect on the matters discussed." Afterwards, members voted on the "clicker" technology and it was unanimously approved for future use in facilitating decisions.

Treatment Scenario Development –

Review - Presentation by Haydee Hampton

First, Hampton briefly outlined the information covered from the last meeting, related to layer analysis, wildlife issues, treatment scenarios, spatial data, and guidelines. Then, she provided a working group meeting timetable for members: 6/4, 7/18, 8/17 meetings would be used for developing a draft of the treatment scenario(s) to be included in the 9/7 progress report; 9/17 would reflect the revised treatment scenario(s) and a discussion of the results of the forest growth review; 10/15 would include the finalized treatment scenario(s), a review of wood volume layer,

treatment definitions, and information regarding the wood user database; 11/16 would include a discussion of the wood supply results and the potential economic impact; 12/1 will focus on the final deliverables of the proposal.

Hampton then segued into the PowerPoint presentation about the treatment scenario development. She began by discussing the "Western Mogollon Plateau and White Mountains Landscape Assessments" – supported by NAU, covering approximately two million acres each. She encouraged members to evaluate the Work Book contents with information about the treatment scenarios developed during these landscape assessments. Furthermore, Hampton asked working group members, "Did you attend the Western Mogollon Plateau adaptive landscape assessment or the White Mountains landscape assessment?" Ten group members indicated that they did attend the meeting, while one group member responded that they did not.

Hampton then provided a slide of a wood supply analysis map that provided boundaries of the assessment for the current study. She also provided information about previous landscape assessments – (about 50 stakeholders attended the landscape assessment workshops in Pinetop and Flagstaff); Hampton discussed the conceptual approach for landscape prioritization and provided another map that showed the prioritized areas in need of management attention. She described how previous researchers identified and prioritized the landscape values and risks, as well as the spatial layers represented in the research (they applied weighting factors according to priority level). Hampton indicated that the spatial layers that receive priority ranks were considered, in terms of how they are identified, weighted and overlaid to construct a composite map.

Next, Hampton covered the findings from the research of the highest priority values and risks from the previous assessments in the analysis areas. She clarified that "values" included human communities and infrastructure, water features, biodiversity, and key forest indicator species, while "risks" included fire hazard and behavior, fire risk, post-fire erosion and sedimentation potential, and tree density. She provided three spatial layer maps that revealed the priority layer development process; there were three maps included to demonstrate how this process was done in the past. The development process was explained as a three-fold process:

- Define management objectives (e.g., reduce the risk of uncharacteristic wildfire)
- Select areas in need of management (e.g., areas predicted to experience crown fires in dry years)
- Recommend management action for those areas (e.g., plan intermediate intensity thinning followed by prescribed burning in areas predicted to possibly crown)

Following this, Hampton presented several examples of objectives from previous assessments in the analysis areas:

- Protect communities and important infrastructure
- Maintain water quality in municipal watersheds
- Protect and enhance habitat for endangered species and minimize treatment impacts
- Restore grasslands

- Protect and maintain the biological integrity of riparian and aquatic habitats
- Increase the quality and extent of special habitats, such as aspen stands and pine-oak woodlands.

In addition, a spatial layer of the management objectives for crown fire and interest in minimizing fire plus a thinning map were combined to equal treatment areas across the landscape. Hampton added that the team could take the high priority areas and move forward with them. At that point, she asked the working group members how they could use the previous assessments for the wood supply analysis. Working group members were encouraged to choose either, "Not use them at all", "Consider, select, and build on relevant components from previous scenarios", or "Use prioritization and/or management action layers from previous assessments". One comment from a working group member was to wait to use these previous assessments until data were collected for the current project. Two other members added that considering, selecting, and building on relevant components from previous scenarios would be relevant and useful for the future interests and progress of this group.

Then, Hampton encouraged a discussion into ways to evaluate potential sustainability over certain time periods while considering the following:

- Identify acres available and appropriate for restoration (e.g., thinning and prescribed fire treatments)
- Identify the restoration objectives for those acres
- Build agreement on the size and location of treatments necessary to reach the restoration objectives
- Estimate the volume of supply following recommended thinning treatments.

One group member emphasized the need to look at "what's off the table" in terms of acreage available. Another group member commented that he was not familiar with the prioritization process, adding that it may or may not be useful for issues the group is discussing. He thought this process could facilitate some decisions made about topics – "We need to start from scratch and move forward and see how the assessments unfold." In addition, a group member commented that, "other factors need to be considered in the decisions made about which areas to include or exclude."

Hampton continued her segment by acknowledging that three tribal representatives are on the wood supply working group. She mentioned that in discussions with these representatives she learned that the White Mountain Apache Tribe might consider providing reservation-wide wood volume figures to the wood supply analysis if prompted. At that point, one group member indicated that he doesn't usually deal with the small diameter class and thinning programs, as his logging company usually deals with larger diameter classes. Therefore, he felt he could not comment very much on this topic.

Hampton went on to indicate that she spoke with Susan Johnson of Region 2 Forest Service and found our from a working group member that there was a tribal land resolution that would allow Johnson to conduct her study (funded by the Ford Foundation) on their lands.

However, Hampton inquired about the wood supply analysis being conducted on tribal lands too; evidently, the tribes were not necessarily interested at this time.

Treatment Characterizations and Strategically Placed Treatments – Presentation by Brett Dickson

Brett opened his presentation with coverage of the treatment characterizations (Ponderosa Pine-dominated strands). He explained that he was going to cover the various treatment alternatives and how they are developed and quantified. The treatment alternatives included 1) high-density thin (i.e., light burn); 2) intermediate intensity thin + light burn; 3) low-intensity thin + light burn; 4) heavy burn only; and 5) light burn only. He indicated that all the treatments were further explained in Tab 9 of the workbook.

Next, Dickson discussed the tools that were utilized in building a management action scenario, which covers the treatment alternatives of the landscape. He also reviewed the treatment effects on forest structure, to include before basal-area treatment and after basal-area treatment. He presented spatial data on the treatment effects on fire hazard (before) and heavy burn (after). Lastly, he included another option, within the FlamMap fire behavior program (in cooperation with USFS RMRS Missoula Fire Lab). This option included key LANDFIRE-derived input maps for:

- Crown bulk density
- Crown base height
- Canopy cover
- Canopy height
- Elevation
- Slope
- Aspect
- Fuel model (includes 21 different models)

Dickson also provided several additional slides, which included information about the predicted heat output if a fire occurred (fire hazard), crown fire behavior (when a fire transitions from a ground fire to passive to active crown fire), and the Treatment Optimization Model (TOM). He explained that TOM is a FlamMap-implemented algorithm used to optimize the placement of treatment units that limit and interrupt the movement of large fires, given user defined ignition points. He followed this with data related to current fuel conditions and potential fuel conditions after treatment. He explained that the data from the TOM model identifies major fire travel routes and their intersection with user-identified areas for treatment.

Dickson reviewed a "straw man" process that the group might use to develop their treatment scenario, using FlamMap's TOM. This process consisted of several steps:

- Develop layer of priority areas across analysis area
- Develop layer showing potential treatments
- Run TOM to select optimal areas (e.g., 10 or 20% of total area) for treatment
- Use prioritization process to provide preferred sequencing within TOM areas

Q: How can you convert percent reduction in forest structure metrics to actual values such as a basal area goal?
A: Dickson responded that other programs are available to convert these values, but they were not used for the purposes of this study.
Q: Is there information about what we end up with (target objectives) instead of the percent reduction values?
A: Dickson indicated that the literature was constrained and therefore the best metric was percent reduction instead of looking at target objectives.
Q: How is the use of the FlamMap model with and without TOM related?
A: Dickson explained that TOM is an alternative to using the fire hazard and behavior FlamMap outputs and he just wanted to make it apparent to the members; TOM is geared to minimizing fire spread.
Q: Is there a program that would allow members to look at what the existing conditions are and what they desire for that acre?
A: Dickson indicated that it wouldn't be a difficult exercise, as long as the parameters are explicit.
At that time, one member indicated that she agreed that it is a challenge to think about percent reductions in stem density, basal area and other metrics, but instead would rather consider the desired conditions – easier to consider for foresters. Dickson added that he has 10-12 relevant citations that he can point people towards.
Romero presented an idea to provide a list of citations that will be available for group members, either on the website or in a handout.
Q: Is this going to be an effective tool for us to look at areas from the SW?
A: Dickson alluded to the fact that there is existing data that dates back to the 1970's that includes tribal information, for fuel characteristics and fire structure – federal data exists about fire risk too.

Dickson continued the presentation by relating the information provided at the June 4 Wood Supply Working Group meeting by Sarah Lantz and Shaula Hedwall and in some follow up meetings indicating that there are certain areas where not to target treatments that he has worked on modeling spatially:

- Canyon rims
- Steep slopes
- Seeps and springs
- Known nest sites

He reviewed how canyon features were discriminated using a method that entails partitioning the landscape into the following elements: canyon bottoms, ridgelines, and areas of gentle and steep slopes. He showed a map dividing the analysis area into locations with <40% slope and >40% slope; the members of the wildlife small group indicated that steep slopes are associated with greater diversity of wildlife and are thus relevant to the current research. One group member commented that steep areas should not be excluded, but included as potential future sources of small diameter wood. Another group member commented that very rarely do treatments occur in areas with over 40% slopes.

Dickson also included a map outlining the springs and seeps in the area of focus, as well as database results of raptor nest locations throughout the area. He explained that the wildlife team was working with people to acquire more data on the nest locations – "it is an ongoing process".

Guidelines Regarding Wildlife and Wildland Urban Interface (WUI) – Presentation by Brett Dickson

Dickson indicated that they would like to form a small group to help come up with ideas to quantify information on WUI areas. At that time, the team did not have complete information about the CWPP priority areas (e.g., Williams and Blue Ridge); Dickson suggested that further discussion about this issue needed to come from the working group members. He went on further to say that the two WUI definitions could be used to form a complete WUI layer across the analysis area: CWPP priority areas and where CWPP have not been completed 0.5 and 1.5 mile buffers around private lands, but that requires more consideration too. A map of the USFS R3 15-year WUI areas was also presented.

Tom Sisk told members that the team wasn't sure how these models fit into the wood supply analysis quite yet, but he acknowledged that this is where the working group fits in – to help find ways in which this information can be used. One working group member then noted that the group needs to discuss "what is acceptable/not acceptable" for treatment, and to find ways to address this. Dickson then told members that he can use the data to provide applicable findings to inform the group about making decisions, although he made it clear that he was not trying to trump the group member's decision-making process. Rather, the support team wanted to respond to what was indicated last meeting and make sure they could find ways to incorporate as much as possible into the wood supply analysis. Another working group member indicated concern that the same things should not be done in every situation.

Guidelines Regarding Streams, Soils, Access, and Mechanized Equipment – Presentation by Haydee Hampton

Here, Hampton wanted to focus on a discussion of the treatment guidelines for soils and steep areas. More specifically, she highlighted two major points provided by ASNF staff:

- Avoid treatments on highly erodible soils (datile and cinder soils in this area)
- Mechanical treatment on slopes >40% requires specialized equipment – for example a TIMCO can go up to 60% slope.

A working group member explained that the cost and lack of availability of the specialized equipment restricts mechanical treatments' use in steep slopes. Another member added that the economics determine what treatment options are available and are used.

Next, Hampton commented on streamside management zones (Tab 9 in the workbook) delineated by ASNF staff to protect stream water quality. She explained that ASNF recommend avoiding mechanical treatment within "filter strips" 75 to 300 feet of certain streams depending on several factors. Hampton showed GIS layers that could be used to define variable width streamside management zones according to slopes and stream types, and the presence of native

fish species in the area. She is working on obtaining information from other Forests and jurisdictions. The State lands working group member indicated they used guidelines provided by the Coconino and Kaibab NFs.

Hampton moved on to describing the access options available to treatment areas, but relayed that working group members have indicated that roads are widespread, but it is their condition that can limit access. Also, she explained that the BioSum roads layer was built from Forest Service roads (core and CFF) and ALRIS TIGER street files. One working group member noted that areas where there aren't any roads should also be considered in the analyses. Another member added that the reservations have considered the 40% slope, but the costs are not feasible to include this factor. Finally, another group member commented that the working group should maintain whether the issue is economic or environmental – these issues/considerations should be kept separate from each other, and if it's an economic issue, it needs to be dealt with differently.

Vegetation Types, Wilderness Areas and Other Primary Factors – Presentation by Jill Rundall

Rundall wanted to address the study area (5.5 million acres), including the four relevant forests and two Native American areas as well.

Q: Why was the Young area (Pleasant Valley Ranger District, Tonto NF) not included in the ponderosa pines area?
A: Hampton answered that there wasn't really an effort to exclude it -- the ad-hoc committee didn't recommend it be included in the study.
At that time, a working group member commented that it was likely just an oversight. Another member commented that the Clifton district could likely be excluded because it didn't garner a large ponderosa pine inclusion. Hampton suggested that the Clifton District will be essentially removed as this process in focused mainly on ponderosa pine.

Rundall continued with her presentation by examining the different vegetation types in the analysis area. Rundall showed a layer of the dominant vegetation. She stated that there was approximately 2.2 million acres of ponderosa pine dominated areas found in the designated research area. Other group members considered removing Special Designated Areas (e.g., primitive areas, Wilderness areas, and Inventoried Roadless Areas), but Rundall explained that these areas would likely fall under the category of not being able to be treated mechanically. Furthermore, she added that if Specially Designated Areas were removed from the group's treatment scenario that 1.87 million acres of ponderosa area remained of the initial 2.2 acres. A series of map layers illustrated the ponderosa pine areas remaining after these various considerations were removed.

Rundall then explained that she is collecting many different types of information, including planned and historical treatment types and treatment dates, for use by the group to determine if another treatment is/was needed. She explained that the treatment layer for the ASNF was not up to date at that moment, and as a result contains 2001-2004 data for its most current information. She is in the process of requesting more recent data from the Forests and other jurisdictions in the analysis area. Other layers available to the group for use in their scenario include estimates of burn severity, which is related to vegetation death, following a particular fire. She also explained

that the USDA provides insect and drought related tree mortality estimates throughout the area; these layers may help to narrow down the available areas to which we can apply treatment. Rundall encouraged members to provide any additional GIS information that would help with this process, and she noted that there are still many layers that the team is in the process of acquiring information (e.g., fuel treatments/Stewardship contracts; tree mortality 2006+, ADEQ impaired waters from A-S; Coconino, Kaibab, Tonto, and others). Two group members commented that Flagstaff City and the AZ state government could provide a fair amount of this information. Randall included that she was researching a system in which she could avoid pursuing 2 different sources and could instead find one combined source for this information.

Rundall also indicated that she is in the process of acquiring information concerning wildland fire use (WFU), fire history, riparian areas, stand exam, and roads. At this point, she has only received information from the Coconino NF for WFU. Also, Rundall tried to get information from the Forests concerning streams and relevant to northern goshawk/Mexican spotted owl and other raptor nest locations; N. Goshawk PFA's/MSO PACs; Wildlife corridors; CWPP (Williams, Blue Ridge, ACWPP, and SCWPP). Hampton made it known to the group that the current information indicated those layers that the team is in the process of acquiring, but they do have lots of other layers already available.

Q: What is your estimate of how many acres of ponderosa pine would be left after all the layers you presented are included in the treatment scenario?
A: Rundall explained that she couldn't guess because it would depend on how each layer would be used in the group's scenario.
Q: How much might the group decide?
A: Sisk explained that it's pretty hard to guess on such a matter. He added that the answer might be to decide which areas the group is less willing to treat. He reiterated that the information about those layers hasn't been acquired by the team just yet.
Two group members informed the others that there has been very little treatment in Tonto, Coconino, and Kaibab NFs. They explained that there is likely to be very little change. Romero suggested that group members contact Rundall in the future to help located up-to-date information and to uncover the "gaps" in the acquisition process.

Brainstorming Session – Facilitated by Rosemary Romero

At that time, Romero opened the floor to the group members to provide information that would pertain to Rundall's presentation. Hampton suggested Working Group members look for information about layers available to them in the White Mountains Landscape Assessment data atlas available in the workbook as 80 to 90 percent of the layers we've discussed are in that document.

Romero suggested a bulleted list of additional factors to consider for the analysis:

- Mining claims – has no bearing on this analysis
- Grazing leases – has no bearing on this analysis
- Existing contracted timber sales
- Stewardship contracts
- Culturally significant sites

- Private wells/tanks
- Municipal watersheds

The group members decided that the mining claims and grazing leases have no bearing on the analysis, while Hampton also added that the team already had some data available on the municipal watersheds.

A group member then asked about the steps that are needed to go through to get all of these things accomplished. This group member acknowledged that the spatial data was comprehensive, but felt that a road map on how to proceed needed to be reached by consensus. The group member commented that they didn't feel that the group knew where it was going. Romero clarified that the actual approach "road map" was not yet decided. She reiterated that the team provided the data and located the gaps, and it was the responsibility of the working group to decide which approaches to follow. Hampton added that the team had data from what other groups had done and one possibility was to follow what other groups had done or NOT do what those groups did. Similarly, another group member commented that the group needed to prioritize these areas and come up with categories that will help the group to decide the treatments and the products that the treatments will generate. At that time, both Hampton and Romero suggested going through the layers and thinking about which layers can be eliminated or kept.

Q: Should we eliminate Wilderness Areas from the group's treatment scenario?
Group discussion: One group member felt that Wilderness areas did need restoration, but that the group didn't need to go there first. Instead, the member suggested a two-tier approach for prioritization. Another group member indicated that they disagreed with a 1-2-3 prioritization approach, and the group should try another approach instead.
Q: What do we mean about treatment (mechanical or something else)?
Group discussion: One group member responded to this question by commenting that the group needed to think about the treatment in relation to the wood supply production, since that was the whole basis for the working group formation. Another group member agreed that the objective of the group is a wood supply analysis. This member added that the group should focus on the wood that could potentially produce a product. A third group member expressed their agreement on this issue and added that the objective is to figure out the tons of wood that can come out of these areas. This member added that the group needed to focus on these areas of treatment that will help production, and that a discussion about treating areas with steep slopes using cables was off the table and a non-starter for the conservation community.

Q: Is there something that the team has that suggests to us that those areas are good candidates for mechanical treatment because they're overstocked?
A: Dickson responded by claiming that the tree density layer could be included in the decision process. He concluded that the ForestERA team could assist with its use.
Q: How do we determine which areas are best treated with prescribed fire? Can we identify these areas where burning is going to be most effective?
A: Tom Sisk answered these questions by explaining that there are two different approaches:

1) identify the areas that are off the table and the areas that are suitable for mechanical treatment, and 2) identify those areas where mechanical treatment is possible, but determine which treatment type is most suitable.

One group member expressed their concern about the accessibility issues. They felt that it was difficult to accomplish the road mapping, but they also felt that it was a key point in determining what is possible. Two group members indicated their desire to discuss what restoration means to the group and what the group's objectives are.
Q: What are we considering "roads"?
A: To this, one group member concluded that road building is a flash point, since temporary roads are being added all the time. This group member expressed their interest in developing some agreed-upon road network, and that experts can be consulted about the road mapping.
Q: How much wood do we have? How much underbrush will be thinned out and how much will replace itself?"
This same group member explained that their organization spends about 40,000/month on roads, and there were problems when working with the Forest Service.
Q: What is the potential availability for forest growth/replacement in the model? Can the model do that? Hampton responded that Gary Snider is researching forest growth assumptions as part of this analysis.

At that time, Romero transitioned to the brainstorming session on restoration objectives for areas available and appropriate for restoration. Romero proposed the idea of having a small group discussion concerning road mapping. To this idea, one group member expressed their opposition to small groups, because they felt that format didn't necessarily mean that group members would come to an agreement as a large group. This group member also expressed that there was a dichotomy with what was mapped and the wooded area in the White Mountain Apache Reservation, because it is part of the regional supply and should be actively engaged in the supply line. In response to this, Hampton turned the discussion over to a representative from a local tribe group. This representative commented that the tribe has some desires to keep their data confidential, but would consider working with the team, if they felt their data could be protected; they just need a clearer idea and then they can take that proposal to the tribal council and see if it can get approval.

The issue of agreement about defining "restoration" was left for the next meeting, since two working group members, who were proponents of defining it, had to leave early.

Wood Estimation Analyses – Presentation by Gary Snider

Snider (Forest Economist and Doctoral Candidate, School of Forestry, NAU) explained that he has provided several resources for group members, including a handout for the current session and some additional materials in the workbook. Included in the materials are sources from Dwayne Walker, which includes how much material will be taken and where it will be delivered. Snider reiterated that he will provide a comprehensive list of what is being extracted, where it's going, who is receiving what, and so on. Snider also indicated that he would include information

related to growth rates. These materials will be sent out to group members at some point. His handout provided information about the primary, secondary, and tertiary wood producers within the realm of the present study.

Wood Volume Layer by Tree-diameter Class – Presentation by Haydee Hampton

Hampton provided information that focused on wood volume layer development, which may incorporate imputation methods that link multiple vegetation layers and plot data to common "vegetative states" (e.g., similar to R1 vegetation mapping project (VMP) methods). This is only one of several methodologies ForestERA is considering. She highlighted the spatial and plot data updates that had been made since the June 4th meeting. The data included a US Forest Service Region 3 image segmentation layer with several attributes including canopy cover and dominant tree size. She explained that there are several additional steps that need to take place:

- Combining and arranging plot information in one database, planning additional plot data acquisition, and testing various diameter class breaks
- The selection of diameter classes will be a combination of what is possible given available data and what is of interest to the working group and the stakeholders
- Stakeholders have expressed interest in the following classes: (<5 or 6 inches DBH, 5-9, 9-12 or 9-16, >12 or >16, 16-24).

Hampton said that they are aiming to get sufficient accuracy for three, possibly four classes, but again this has not been decided. She emphasized that it is not possible to provide detailed information for all class breaks.

Romero and the support team then took a few minutes to develop language with the working group defining a "Road Map" for use in developing treatment scenario(s):

- Identify areas appropriate for restoration treatments that recover wood byproducts (i.e., "What's on the map?")
- Define management objectives (i.e., "target conditions")
- Selection of appropriate treatments.
- Prioritization? (No definitive answer on how to address this emerged.)

In addition:

- Calculate supply produced by applying the appropriate treatments across the map.
- Once forest growth recommendations are available, discuss as group how to use them in this study.

The group and team members also asked if there were any volunteers from the Working Group to serve on small topic groups, which would bring straw man ideas to the larger group for consideration:

- Small group formation (ForestERA is looking for volunteers)
  - Wildlife – Brett (so far includes Shaula and Sarah)
  - WUI information– Brett (Steve Gatewood was recommended to be in this group)

- Roads – Haydee (other members TBD)
  1) What road layers are out there?
  2) What are they used for?
  3) What are the appropriate methods for restoration?

Comments from Observing Public

- Ruling out areas because there are no roads on the Forest Service's roads GIS layer would be wrong as this may or may not mean there are existing roads. Leave all ponderosa areas in the analysis, I guarantee there will be roads there, unless it's really steep, regardless of whether there are current roads there or not.
- Include existing NEPA and treatment plans that have been made. Include the collaborative efforts over the last 10 years of the Greater Flagstaff Forest Partnership for the 180,000 acres surrounding Flagstaff
- The cleanest way to deal with roads is not to exclude any areas due to road access; assume an appropriate method will be found to access any area.
- In one area there are tens of thousands of wood piles sitting in the forest today. What are you going to do with it? If you burn it, it will create smoke and global warming issues.

Note: The next meeting is in Flagstaff, Friday, August 17th. Directions to the facility will be provided. Draft meeting summaries will be sent out to Working Group members and members will be given two weeks instead of one to provide comments at the request of one working group member.

Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona

August 17, 2007
9:00 a.m. – 4:15 p.m.
Applied Research and Development (AR&D) Building
Northern Arizona University, Flagstaff, AZ

9:00 – 9:15 a.m.	Welcome – *Rosemary Romero* (Facilitator, Rosemary Romero Consulting)
9:15 – 9:30 a.m.	Review meeting agenda and "road map" developed by Working Group at July 18 Wood Supply meeting **–** *Haydee Hampton* (Research Associate, Environmental Sciences, Northern Arizona University)
9:30 – 10:30 a.m.	**ACTION ITEM 1: Select areas appropriate for restoration treatments** Working Group decision-making session to identify areas appropriate for restoration treatments that recover wood byproducts **–** ForestERA technical support by *Jill Rundall* (Senior Research Specialist, Environmental Sciences, NAU), *Brett Dickson* (Assistant Research Professor, Environmental Sciences, NAU), *Steve Sesnie* (Postdoctoral Research Associate, Environmental Sciences, NAU) *and Haydee Hampton*
10:30 – 10:45 a.m.	Break
10:45 – 12:00 p.m.	Select areas appropriate for restoration treatments (cont.)
12:00 – 1:00 p.m.	Lunch *** Optional Applied Research & Development building tour 12:40 – 1:00 p.m., *Richard Baron*, AR&D Building Manager) ***
1:00 – 2:30 p.m.	**Restoration options** Presentation on recommendations for restoring ponderosa pine forests from the Statewide Strategy for Restoring Arizona's Forests and other sources **–** *Tom Sisk* (Professor, Environmental Sciences, NAU) Facilitated discussion on fuel and restoration treatments of interest to Wood Supply Working Group **–** *Rosemary Romero*

2:30 – 2:45 p.m.	Break
2:45 – 3:45 p.m.	**ACTION ITEM 2: Select treatments based on management objectives** Brainstorming session on the selection of treatments of interest to Working Group **–** *facilitated by Rosemary Romero* Optional additional information: Map-based treatments recommended by collaborative groups in the Western Mogollon Plateau Adaptive Landscape Assessment (WMPALA) and the White Mountains Landscape Assessment (WMLA) **–** *ForestERA staff*
3:45 – 4:00 p.m.	Updates on available spatial data and wood estimation analyses and logistics for next meeting
4:00 – 4:15 p.m.	Public comment period
4:15 p.m.	Adjourn

Meeting Summary
Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona
August 17, 2007, Applied Research and Development (AR&D) Building
Northern Arizona University, Flagstaff, AZ

Introduction and Agenda Review

Rosemary Romero: *Welcome*
Romero (Meeting Facilitator) welcomed back the working group members and observers to the third group meeting. She opened the meeting with reading the letter from Harv Forsgren, Forest Supervisor for the Southwestern Region of the US Forest Service, which was distributed to participants at the July 18, 2007, Working Group meeting in Pinetop and is posted on Documents page of Wood Supply Analysis web site: http://www.forestera.nau.edu/project_woodsupply.htm) concerning how the Southwestern Region would use the results from this study. Afterwards, she asked everyone present to give brief introductions.

***Working Group members present at meeting (in order of presentation)*:**
1) Keith Pajkos, Timber Staff for the Arizona State Lands Department Forestry Division
2) Scott Higginson, Executive Vice President of NZ Legacy/Snowflake White Mountain Power, Renergy
3) Molly Pitts, Executive Director of the Northern Arizona Wood Products Association
4) Herb Hopper, Community-based forest and wood products Advocate, Little Colorado Plateau Resource Conservation & Development
5) Steve Gatewood, Consultant, Wildwood Consulting Inc., representing the Greater Flagstaff Forests Partnership
6) Ethan Aumack, Director of Restoration Programs for Grand Canyon Trust
7) Rob Davis, President/Owner of Forest Energy Corporation/Future Forests
8) Bill Greenwood, City Manager for the Town of Eagar
9) Bob Taylor, Supervisory Natural Resource Specialist for the Apache-Sitgreaves National Forest
10) Jerry Drury, Timber Staff Officer for the Kaibab National Forest
11) Kim Newbauer, Timber Sales Contracting Officer for Coconino National Forest
12) Pascal Berlioux, President and Chief Executive Officer of Arizona Forest RestorationProducts, Inc.
13) Sarah Lantz, Urban Wildlife Planner for Arizona Game and Fish Department (Region II Flagstaff Office)
14) Lisa McNeilly, Northern Arizona Program Director of The Nature Conservancy
15) Diane Vosick, Associate Director of the Ecological Restoration Institute (Wally Covington, Director of the ERI and NAU Forestry Department Regents' Professor filled in for Diane part way through meeting).
16) Larry Stephenson, Executive Director of the Eastern Arizona Counties Organization (ECO)/Economic Environmental Counties Organization (EECO)
17) Todd Schulke, Forest Programs Director for the Center of Biological Diversity
18) Shaula Hedwall, Ecological Services, U.S. Fish and Wildlife Service

***Working Group members not present at meeting*:**
1) Robert LaCapa, Forest Manager, DOI BIA Fort Apache Agency Branch of Forestry
2) Chuck Peone, Fort Apache Timber Co.
3) Paul DeClay, Tribal Forester, Forestry Department, White Mountains Apache Tribe
4) Elaine Zieroth, Forest Supervisor for Apache-Sitgreaves National Forest (alternate present: Bob Taylor)

Meeting observers:
1) Wally Covington, Ecological Restoration Institute
2) Sue Sitko, The Nature Conservancy
3) McKinley-Ben Miller, BLM-AZ
4) Rich VanDemark, Southwest Forestry
5) Michael Smith, SW Forestry
6) Chelsea Lett, Congressional Liaison, Congressman Renzi
7) Stacey Hamburg, Sierra Club

Romero then turned the floor over to Haydee Hampton, the Forest Ecosystem Restoration Analysis (ForestERA) Project Manager leading this collaborative effort.

Haydee Hampton: *Wood Supply Team Introductions and Agenda*
Hampton formally introduced Steve Sesnie, a new ForestERA Project team member who received his Ph.D. from the University of Idaho and recently worked on the LANDFIRE project. She indicated that Sesnie will be working with the group for the remainder of the current project.

Hampton then began reviewing the meeting agenda and the "road map" developed by the working group at the July 18th Wood Supply Meeting in Holbrook. She presented information concerning the "roadmap to develop the treatment scenario". Hampton informed the working group members that the ForestERA Project Team developed the slides and presentation in response to comments given by group members, as well as the results of the small group discussions. She also indicated that the group members would have the "clickers" available again to determine group agreement and promote discussion on some issues.

Hampton continued her segment by explaining the conditions of the roadmap for group members. She presented a PowerPoint slide with the main points of the roadmap:

- Identify areas appropriate for restoration treatments that can recover wood byproducts (i.e., "What's on the map")
- Define management objectives (target conditions) to guide selection of treatments
- Select appropriate treatments. Several layers that might be useful include:
    - Fire hazard
    - WUI
    - Wildlife areas

- Prioritize areas in order to define preferred treatment sequence?
- Calculate supply produced by applying the appropriate treatments across the map

Hampton mentioned to group members that the ForestERA Project Team has acquired and developed map-based information for the analysis area, but she also wanted to make it clear that the working group should not feel constrained by those maps. She felt that the maps could act as a guide for helping group members in their decision-making process, but they should not be the sole source of information. Hampton also included a timetable for the group members, in order to let them see their progress and what lies ahead for future meetings:

- *June 4* – Provide background and description of wood supply analysis and discuss treatment scenarios available, spatial data, and agency guidelines
- *July 18* – Agree on workshop decision-making process and work towards developing treatment scenario. At each meeting, review and respond to stakeholder comments/questions submitted between meetings, review layer acquisition and provide analysis updates
- *Aug 17* – Develop draft treatment scenario to include in Sept.7th progress report
- *Sept 17* – Revise treatment scenario and discuss treatment characterization and results of forest growth review. Decide on need for Oct. 9 optional meeting.
- *Oct 15* – Finalize treatment scenario, review draft of wood volume layer and wood use database. Decide on need for Oct 29 optional meeting.
- *Nov 16* – Discuss wood supply results; discuss potential economic or other follow-up analyses

Hampton then moved onto discussing the expansion of the analysis area to include the Pleasant Valley Ranger District. She wanted to get back to group members about this issue to let them know that all new data collection will include the Pleasant Valley Ranger District. To illustrate this, Rundall displayed a map on screen to show the additional area that would be included in the new analysis.
Q: Has the White Mountain Apache Tribe been included in this analysis? What is the progress? Hampton responded by saying that the tribe may provide a reservation-wide wood volume estimate. She indicated that the ForestERA Project Team was talking with tribal members and that they would find out soon if tribes were willing to provide this information. One group member commented that the group should be careful when saying "putting wood on the market" because tribes' wood isn't on the market at this time. It's just potential wood supply. Another group member added that they were not sure these tribes were willing to make these decisions, but that they have a lot of wood that is ready to be put on the market. This group member thought that this information could be added to the analysis as a footnote. Romero then added that the issue is a sidebar that the group could revisit.

Hampton moved forward and presented a slide with "Steps for reaching agreement on scenario components". She reminded group members about the use of clickers to gauge agreement and indicated that there were "hard-wired" questions on the Power Point (PPT) slides, but that the group could add impromptu or "verbal" questions at any time. Hampton also showed the clicker "response report" from the July 18th Working Group meeting for group members to see their responses and to highlight the information that could be included in project reports. Hampton then reviewed the analysis area, and referred to a slide outlining various areas under consideration for the Working Group treatment scenario. She discussed the treatment guidelines for steep areas, and mentioned that mechanical treatments on slopes > 40% generally require specialized equipment and that the Forests require special approval for use of mechanized equipment in these areas. Based on conversations from the group's previous meeting, Hampton then had the group register their votes on the following issue:

- Steep areas (>40% slope) are not a source of small diameter wood supply to be considered in the working group's scenario.

Eighteen group members indicated their level of agreement using the clickers: [Strongly Agree = 9 members; Agree = 6 members; Neutral = 2 members; Disagree = 1 member; and Strongly Disagree = 0 members]. One group member commented that although the group discussed briefly that they agreed on this issue, they wanted to encourage others to discuss contentious issues, especially if some group members disagree with particular issues. Another group member added that the group was not afforded sufficient time for discussion after using the clickers on the slope issue (one member had indicated disagreement on the issue), and if this continued that issues that really mattered would not get aired. Also, they thought displaying the clicker results in project reports would not promote discussion, which is what the group needs for this process. Here, Romero commented that there would be plenty of room for discussing the harder issues.

Hampton then transitioned into presenting information concerning erodible soils. She explained that the ForestERA Project team was collecting map-based information from the soil scientists at each of the four Forests in the analysis area on soil types on which the Forests have timber harvest limitations (that is, rated as too erosion prone for mechanical treatments). She explained that the Forests had indicated that these were conservative estimates since sometimes areas will be released to harvest after inspection. The ASNF provided a rough estimate of 20% of the areas mapped as off limits due to erosion hazard may be released. Hampton explained that ForestERA had acquired data on soils with timber harvest limitations from the Apache-Sitgreaves, Kaibab and Coconino NFs, but not yet from the Tonto NF. In addition to soil types with harvest limitations, Rory Steinke, Watershed Program Manager for the Coconino and Kaibab NFs, provided the level of difficulty (fairly easy, somewhat difficult, and difficult) of mitigating impacts from mechanized treatments with best management practices (BMPs). Steinke recommends the group only consider the soil types classified as difficult to mitigate in their scenario. Hampton displayed a map of soils with harvest limitations. Q: What percent of the ponderosa pine area have erodible soils? Hampton responded that ForestERA had not done this calculation, but offered a guess of about 3%.

Q: What's the difference between highly erodible, moderately erodible, etc.? Hampton responded that the Forests did not supply information in terms of levels of erodibility, only in terms of having timber harvest limitations. However, the Kaibab and Coconino NFs had provided information on the level of difficulty of mitigating impacts from mechanized treatments with best management practices (BMPs).
Q: Where will we draw the line? What is acceptable? Another working group member responded to these questions by saying, "Only highly erodible soil is where they would consider restricting mechanical treatment."
Q: Are you mapping the highly erodible sites? Hampton explained that the soil scientists gave the ForestERA Project Team information on specific soils types where mechanical treatments would be limited. She added that one of the Coconino/Kaibab soil scientist recommended that the team consider the most difficult areas to mitigate. A map was then projected that included the somewhat difficult areas, as well as the difficult areas shown previously.
Q: Should we consider both the highly difficult and somewhat difficult soil areas, or just consider the highly difficult areas?
One group member conveyed that they would like to remove from consideration those areas that are highly difficult. Another group member explained that highly erodible soils are a concern as the soil capacity can be removed rapidly in those areas, such as in the Red Rock areas. Romero then asked the group if erodible areas should be removed from the scenario. Group members agreed that these particular areas could likely be removed but they would like more discussion. One group member expressed their agreement in learning more about this issue; they claimed that they thought it might be informative to have some sort of gradation on those areas which would be included or excluded, in order to prioritize. Hampton suggested to group members that she could obtain additional information regarding this topic for the next meeting.
Q: Will we have understanding on topics in which there are definitive wood supplies and numbers about areas that are "possible" wood supplies? Hampton responded that it was up to the group as to whether they would like to define these types of supplies in their scenario.

Hampton continued with her presentation; she presented a new slide on treatment guidelines for "streamside management zones". The guidelines included the following information:

- SMZ are delineated to protect stream water quality
- ASNF recommends avoiding mechanical treatment within "filter strips" 75 to 300 feet of certain streams depending on several factors:
  - three erosion hazard levels based on slope
  - perennial, intermittent, and ephemeral streams
  - waterways identified by ADEQ as "unique" or "impaired"
  - presence of habitat for ESA listed aquatic species or other fish species

Hampton also mentioned that Coconino National Forest recommends 66 to 99 feet off stream courses, and she informed group members that the team was still collecting information from Kaibab National Forest and Tonto National Forest on these zones.

Hampton then moved onto viewing a map with streamside management zone slope classes and ASNF stream data. A group member indicated that they would like to make sure that in the calculation of total area removed that streamside mgmt zones are not double counted with steep areas (areas with > 40% slope). This group member added that information on the incremental change for each type of removal would help the group understand the impact of removing additional areas, for example over and above the 40% slope areas already out.
Q: Are we drilling down too deeply? How can we go in and find every land feature that the Forest Service won't let us go into? How do you calculate what is to be taken out? One group member added that the accessible areas could not be determined without going into these areas on foot. Hampton explained that the ForestERA Project team's approach is threefold:

- Map steep slopes, streamside mgmt zones, and other features using available spatial data
- Estimate the reduced treatment intensity, wood volumes or areal extent within project areas due to site-specific factors by developing a list of causes and interviewing ID teams
- Adjust predicted overall wood volumes if map-based data do not sufficiently capture project level factors

In response to this, one group member felt that soil and slope answers might help to answer this question, but moderate erodible areas are still questionable. They added that if the group can answer the first two concerns, then that would help inform the answer to moderately erodible soils. Another group member expressed that they were having trouble *not* seeing numbers, and she suggested that the working group could present acres or percentage changes for each factor considered. Hampton added that the team will continue defining these areas and mapping them out.
Q: Could you bracket the streamside management zones and provide a scale? One group member indicated that operations vary inside filter strips. This member suggested that the group was really talking about a reduction of volume in these areas; they felt that the group could talk about a reduction of these areas, rather than completely wiping them off the map.
Q: How will we get from what can possibly come off to what is actually coming off? Romero indicated that there are topics like this where a small group will be used and has been suggested to help come up with ideas and come back to the working group for the final decision-making.

Jill Rundall: *Select areas appropriate for restoration treatments*
Rundall discussed "treatment data sources", which included three main categories:

- Individual forests, districts and their departments/divisions (fire versus timber staff)
- National fire map – point data only
- Arizona fire map – minimal polygons.

Rundall explained that, as suggested by several group members, she was getting planned and completed treatment data from the Forests and other sources. She then presented a map with point data from Arizona Firemap (azfiremap.org) and explained that this site has minimal polygon data. She indicated that she is still in the process of speaking with an Arizona Firemap representative, as they have told her that more data exists, but it is likely not much.

Rundall then moved onto discussing the completed and planned treatments terminology. She then presented a slide that defined treatment terminology:

- *Planned* – NEPA has been completed
- *Marked* – Timber sale boundaries and trees marked but no buyer
- *Under contract* – timber sale cutting units established and bid accepted; these can be multi-year and extendable.
- *Completed* – treatment accomplished and wood has been removed.

Rundall also remarked about the marked–timber sale boundaries (contains multiple cutting units) and trees marked with no buyer (also called proposed). She explained that these data are relatively new for the forest and haven't been recorded with GIS data until recently.
Q: How does the group want to work with marked treatments? One group member explained that they would put it in the planned category. Several group members agreed to include it in that category as well.
Q: What is the difference between a timber sale and treatment? A group member explained that treatment includes wood that is nine inches or less, and timber sale includes wood that was not specified who is getting the wood, but rather concerns wood that will be sold. Another group member added that marked means that it is still open for sale (sometimes put out for contracts), but was not bid on. One group member asked to re-address the issue of timber sale and restoration, as it relates to those areas in which mechanical treatment might be used in the future. Rundall explained that her analysis was comprised mostly of past treatments. She added that she was just starting to gather the timber units at this time (up to 10 years in the past), and that she was also trying to find out what happened and when. A group member responded that it is complicated because people are taking out timber, but some of the smaller diameter wood just sits on the ground and the Forest Service has to come in and just burn it because it's not in use. Another group member added that they would consider the task orders under contract too, because they have been contracted but have not been cut yet; the task orders have been assigned but not carried out.

Rundall further explained that she was receiving data from multiple data sources (capturing 10 years of data). That data includes the following:

- Fuel, timber, and stewardship contracts
- Year of treatment
- Treatment type
- Treatment intensity (thinning prescription)
- Location in digital format

Rundall also provided a slide that outlined her progress to date:

- Everyone has tried to provide some GIS data
- A-S
  - All available data acquired
  - Stewardship data never completed
  - Request to districts for current cutting unit and stewardship info
- Coconino
  - No available treatment spatial data
  - Acquired some hard copy and acreages of current cutting unit
- Kaibab
  - All available data acquired

Q: Are you treating WUI similar to a completed restoration area? Is our discussion what land should be for analysis and what should not? One group member suggested that many of these areas do not need to be prioritized within the 10-year window. Another group member thought it should go way low on the priority list. Yet another group member explained that the interests of the working group might lead back into those areas treated within 5 years. The member added that the working group needed to get to what is being considered for re-treatment and they thought the WUI areas should be included, but not as a priority because they need to be treated differently. Another group member supported the notion of placing treated areas way down the priority list. This group member pointed out that the acreage that has been treated is much less than the area that needs treatment. In response to these comments about priority lists, one group member explained that they thought priorities weren't going to be talked about; their understanding was that the working group had decided to talk about what's available for the wood supply analysis. This member explained that there is wood available that should be considered because it can be counted towards the final wood supply, and WUI is still part of the supply, but it is not high on the list. Rundall commented that some of the information on treatments which the Forests have spatially is on the stand-level, so does not capture the exact boundaries of the treatments. She added that now, they are trying to capture exactly where the treatment is happening.

At this time, the working group members and the ForestERA Project Team decided that they should discuss whether or not recently thinned areas (completed in last 5 years) should be considered a source of wood supply in the working group scenario. One group member suggested that it could be taken off depending upon how it was treated.
Q: Does ForestERA have a sense of high-intensity treatments represented in your vegetation structure data? Dickson confirmed that the team did have a sense, but noted

that it's a matter of scale. He explained that they could pull out the higher and lower intensity levels. Sesnie added that there would be temporal issues because the data had been gathered from several sources, and the team needed this kind of data to gauge whether treatments have happened after their volume measures. He acknowledged that the data is roughly five to six years old. One group member exclaimed that there was one major issue as to why areas weren't treated - the percentage of landscape that has been treated versus the land that needs it. He added that it might be pointless to include areas that have been more recently treated (as defined by the imagery) because the working group didn't have data on them. Rundall also added that she had a good idea of defining planned and timber sale, and she explained that she would need to meet with people individually to discuss conditions further.

The ForestERA Project team then presented the working group with an issue in which their agreement was needed - "Specially designated areas (e.g., Wilderness Areas) and Inventoried Roadless Areas are not a source of wood supply." Several group members spoke up in agreement with this statement. The group maintained that this should not be included in the analysis.

Next, Steve Sesnie presented information to the working group on tree mortality and disturbance factors affecting wood volume estimates. Sesnie presented aerial sketch map data of forest insect outbreaks, as well as data on drought killed trees, and fire perimeters. He mentioned that data on fire severity is also available. He explained that it was his understanding that the team had data through 5 years. One group member responded by saying that standing dead trees are still usable for up to 3 or so years. Another group member commented that their organization hasn't had to deal very much with beetle salvage, and that it's probably under fire salvage. This member added that it doesn't seem to be very controversial. However, another group member iterated that "dead does not mean non-usable." Sesnie commented that the Forest Service sketch map data do not show high levels of mortality in many ponderosa pine areas, so it's not a large factor.

Rundall then presented map layers of fire perimeters. One group member commented that their only concern was the issue of methodology, so that the group wouldn't count the overlay of what is available and what is not available. Another group member commented that the whole area within the fire perimeters was not totally burned; the partially burned areas should be considered a source of wood supply, too. A group member responded to that by saying that one aspect is utilization, and the other aspect is the lack of consensus about what is salvageable and what is burned. This person felt that the working group should have a discussion of this idea. Another group member added that there isn't salvageable wood any longer in the Rodeo-Chediski area because it has deteriorated so much that it cannot be sold.

At this time, Romero suggested that wood from burned areas would not be included, and that this would be a side bar. A group member responded to this by stating that the group should not exclude the whole red area from treatment because there are lush green areas within that area. Dickson added that the map presented shows only the perimeter around

burned areas, but that spatial data on fire severity is also available. One group member suggested that it would be useful to depict areas with different severities.

Dickson then presented the group with the next PowerPoint slide - *Is protected or restricted Mexican spotted owl habitat to be considered a source of wood supply?* He commented that ForestERA was still stitching together spatial data, mainly on owl protected activity centers (PACs), which we are waiting to receive from Region 3. We have mapped known PACs in the past for the Western Mogollon Plateau and White Mountains Landscape Assessments back (these data goes back to mid to late 90s) and we mapped interpretations of the MSO Recovery plan protected and restricted habitat, which is a challenge to do since protected habitat includes PACs, as well as a composition of landscape characteristics that include steep slopes and pine-oak vegetation. Restricted habitat is a mix of pine-oak where oak contributes about 10% of BA of mixed vegetation component. This fine-scale basal area specification makes it tough to pin down using landscape scale data.

Dickson added that they were looking at developing a map for the entire study area to isolate the restricted habitat areas. You can treat within MSO restricted and protected habitats, but it depends on the forest you're on and the stand you're in too, and depends on how many other PACs have been influenced by disturbance or treatment, so it's a project-scale question. Dickson explained that the maps were important for context on where habitat does and may occur and to think about planning appropriate treatments. One group member clarified that PAC's are occupied habitat and restricted habitat is currently unoccupied habitat that potentially needs management to move towards MSO nesting and roosting habitat. All the forests have adopted the MSO Recovery plan as part of their 1996 Forest plans, so implementation shouldn't be different among forests, although these do come up.
Q: Have treatments been carried out within the PAC's? A group member explained that PAC's have not yet been treated (well only a few) even though the MSO Recovery plan since 1995 allows treatment within 10% of the individual PAC's within a given area (except for a 100 acre nest area), so we haven't been able to make recommendations for improving the management recommendations in the Recovery Plan. Another member offered that there are regulatory minimums on intensity of treatments in terms of BA and canopy cover that we cannot go below (also for goshawks), so we should depict these to make sure our scenario considers what the Forests restrictions are in these areas. A group member responded by stating that the only way to create new habitat is if there is activity in the adjacent areas where a "landscaping" or other minimal treatment can be done. The revised Recovery Plan will not make any major changes in recommendations. It will not be out by Oct. 1 as hoped. Dickson mentioned that the MSO map for the White Mountains Landscape Assessment is available in the handbook (p. 26 of Atlas).
Q: How many total acres do the PACs cover? A group member responded to this question by stating that one PAC is equivalent to 600 acres; there were about 200 PAC's, which equals about 120,000 acres. Another group member commented that there is a lot of debate about "desired" treatment on habitats. One group member then explained that 120,000 acres would not be removed in addition to what the group has already decided to remove, because steep slopes cover some of the same area and also PAC's occur in

mixed conifer and other non-ponderosa pine areas. Several group members then supported the idea to toss out PACs for simplicity sake, and then decide how to deal with the restricted habitat in some way, because there is very little wood that will come out of PACs. The group agreed to do so in their scenario.

Dickson then moved on to discussing the updates to the WUI data. He explained the status of the spatial data, and commented that he was still waiting for information from two Community Wildfire Protection Plans and that only then would the team have a complete picture on spatial data. He also asked working group members about participating on the WUI small group. Steve Gatewood, Sarah Lantz, Shaula Hedwall, and Ethan Aumack all expressed interest in being part of the WUI work group.

Hampton continued the meeting by discussing the availability of road data for this analysis. She acknowledged that the quality of the road data was considered fairly weak. She explained that she discussed the issue of roads with Chris Bielecki, Supervisory Transportation Engineer at ASNF, and he explained that roads are "everywhere"; it's rare that roads are adequate for today's treatment equipment; roads were built narrower and had tighter turns than today's equipment can handle; treatments have been thrown out after completing NEPA due to limited access and high cost to install roads; environmental impacts of upgrading roads can be significant; current road GIS layers are not complete and are only updated on a project by project basis. Hampton relayed to the group that Bielecki recommended that the group consider using a layer based on distance from arterial roads (roads already suitable for mechanized equipment). One group member commented that the group had to really look at the current level of system roads and use that information – don't anticipate other roads. This group member explained that their organization makes these decisions based on no further use, not just whether it will have future harvest use. Hampton also reminded the group that observers from the last meeting indicated that the working group should not consider road access in the wood supply analysis because it was an economic question; if the value of the wood was sufficient, a road to access it could be built.

Q: Is there a proposal on how to handle the road issue? One group member indicated that they didn't know if there was agreement on restoration and the construction of new roads; if so, then the working group could use that information to look at existing areas for harvesting. Another group member commented that it would be nice to see a map that looks at the distance from existing system (arterial) roads. Hampton indicated to group members that the ForestERA Project Team could bring that information to the next meeting. Another group member expressed their worry about relying solely on map layers to interpret the old system, because some subject-matter expertise people have said that it was not reliable. Rundall then provided a road map of the area. A group member commented that there is going to be road work done on roads that were closed before, particularly for semi-trucks that have larger turning radii. Another group member supported this statement and added that their organization had to widen roads, too. They did not see it as an issue. One group member indicated that the working group was focusing on the 3-4% of the area where there are contentious issues, and advised them to look instead at the 90% where there isn't any contention.

Q: Are we talking about enough to justify this area that is not much of a loss? A group member expressed that the working group was not qualified to make decisions about making roads. Romero indicated that the "how" is not an issue for this group, and that they should come back to this issue at a later date, if needed. However, the group consented to reviewing a map at the next meeting of distance from arterial/service roads.

Tom Sisk: *Restoration and Forest Treatments*
Sisk indicated that the key issue for the working group was locating appropriate treatments across the landscape for achieving Region 3's and many others' central priority of restoring fire adapted ecosystems and protecting communities. He explained that there are inherent tradeoffs between thinning (potential to supply small diameter timber and biomass) and burning (typically does not).
Q: Is there an agreed upon consensus for determining where the prescribed fire and Wildland Fire Use are most appropriate without initial thinning? Sisk acknowledged that the group did not have consensus, and that they only had consensus on the tools available for the restoration process. He explained that a wide array of perspectives of how to go about a wide-scale restoration was available.
Q: What conditions would warrant a fire treatment? One group member suggested that the forests evolved with fire historically, and sometimes it is appropriate. They also explained that FlamMap fire behavior and other models help to outline potential fire hazards.

Rundall then presented a map with predicted crown fire behavior (including surface fire only, passive crown fire, and active crown fire; *NOTE that this layer was not displayed properly and thus appeared to underpredict crown fire behaviors*). Sisk explained that these maps should help direct the group to see areas where the group agrees on areas that need thinning or prescribed burning. He mentioned that the working group didn't need to agree on these things now, but that the group needed to make some initial cuts in practical conditions in which the group would advocate fire treatments or heavy thinning. Sisk added that the group shouldn't focus primarily on maps, and advocated that they hold off on looking at the maps. He further explained that the maps could be helpful, but they could also divert the group from the guiding principles of what needs to be done. At this time, the group and team members agreed to turn off the map display. Dickson explained that ForestERA was working closely with the USFS Missoula Fire Lab to recalibrate forest fuel data from the interagency LANDFIRE dataset. These data are inputs in the fire behavior and hazard layers derived by ForestERA using the fire modeling program FlamMap. ForestERA is continuing to improve these layers based on information provided by experts and available ground data.

Sisk iterated that the team wants the group's guidance, as to what treatments should be used in the analysis area.
Q: What about condition class? Sisk responded by stating that condition class is one of the ways the group can go. He then turned the question around to the working group – "How would you use condition class?" One group member explained that the Forest Service uses condition class for determining where to conduct treatments. Dickson indicated that condition class is used on the ground (at a project level), while condition

class data appropriate for the scale of this analysis is not currently available, although the LANDFIRE project is in the process of developing it.
Q: Is there a model that could show us areas to burn (say a Class 1 burn) that will still fall within the parameters of the Clean Air Act? Sisk responded by saying that a one-to-one correspondence between the Clean Air Act and burning thresholds is difficult because those standards are changed day-to-day, dependent upon wind speed and drought conditions. He added that it's difficult to say that the decisions the group make would lead to violations of the CAA on a given day.

At this point, Sisk reiterated that the ForestERA team needed more guidance from the group so that the team could take that information and present it back to the group.
Q: How involved do we want to be in order to meet our restoration objective? One group member suggested that the group think about where they want to get to, and then look at which treatments will get them there. Another group member suggested that the group let the team go through the process that they are accustomed to and see what it can offer. This member also added that they would like prescribed fire too, but the trend is to look at lessening the use of fire. Sisk explained that the team could talk about steps towards describing the treatments used previously. However, one group member explained that they wanted to look at the existing conditions before the group began to think of treatments. This member suggested having a map that allows the working group to look at their predictions. Sisk responded to this by stating that the team had those maps and can do it, but it might be more productive to say that in areas where there is X conditions, treatment(s) Y and Z can take place. He added that the map should come out of the conditions and the treatments, instead of the other way around.

Romero then suggested two ideas: 1) Use the fire small group to discuss things, 2) Work between meetings to develop concrete language. The working group agreed with working over the break, but did not support the small group discussion. Sisk then reviewed a slide and encouraged the group to build their own map by looking at the different treatment types used in previous landscape assessments for the purpose of mapping out what is to be done in particular places. He asked the group whether or not they could come up with conditions on a landscape where one or more treatments are appropriate? He explained that this would give the group direction, as he heard interest expressed before. He added that the second pathway is to provide a set of overlays and go through those areas in a place-by-place manner. He also encouraged the group to have some ideas to brainstorm and make progress towards specificity after the break. One group member stressed the importance of making additions to the existing criteria, but added that the group needed to think about the density on the forest floor - We could add to each criterion something like, <u>(desired treatment condition)</u> if X number of trees per acre exists. Sisk expressed interest in the idea and told group members that they needed to develop ideas similar to this.

ACTION ITEM 2: Select treatments based on management objectives
Hampton began by introducing a new matrix to the working group. It was a scenario worksheet (simplified from what they have used in the past) to delineate information about scenarios and the different facets involved with those scenarios (i.e., criteria layers,

management objectives, and management actions). She then asked the group "Under what conditions would high-intensity thinning treatments be appropriate?"

Working Group member 1: *Management objective* = Places where the area of acceptable risk is lowest and could reduce fire hazard to a particular threshold (e.g., areas close to communities); C*riteria layer* = active crown fire; M*anagement action* = high-intensity thin followed by prescribed (light) burn near communities. Feathered in intensity with distance from communities.

Working Group member 2: *Criteria layer* = MSO PAC's; *Management action* = use high intensity thin followed by prescribed (light) burn 1 mile upwind of PACs; *Management objective* = protect PACs from fire and high-intensity thin followed by prescribed (light) burn in wildlands.

Working Group member 3: *Criteria layer* = rough terrain; *Management objective* = create fire breaks; *Management action* = high-intensity followed by prescribed (light) burn upwind of rough and significant topography. ALSO, *Criteria layer* = canyons; *Management objective* = reduce rate of spread of fire between canyons; *Management action* = high-intensity thin followed by prescribed (light) burn between. ALSO, *Criteria layer* = pronghorn and other open forest species; *Management objectives* = restore habitats of open forest species; *Management action* = high-intensity thin followed by prescribed (light) burn. ALSO, *Criteria layer* = historic meadows; *Management objective* = restore meadows; *Management action* = high-intensity thin followed by prescribed (light) burn.

Q: How can we accomplish our objectives? Dickson responded by stating that the group needed to establish associated criteria to add to the management actions. Romero then asked the group, "What is the language that should go in there then?" One group member suggested that the group could add language that includes what the area could be taken down to. Another group member thought it made more sense to come to terms with the concern about percent reduction. They indicated that the working group seemed to have a lot of comments about this particular topic. This member thought that the group needed to first define their objectives, and they felt as though the group wasn't doing a good job of identifying their future objective and the desired outcomes. Several other members consented that the desired condition was the main objective for agreement.

In response, one group member felt that the group kept discussing the means, but that they weren't really considering the ends (or desired conditions). Another group member added that the group needed to clearly define the desired condition (block-by-block), but that the group also needed to determine how to move from the existing condition to the desired condition. Another group member indicated that they hadn't yet decided what they wanted their areas to look like, but that this is one of the objectives outlined in the road map. This member felt that the group needed to do that before they decided the treatment types for those areas. Several group members agreed with this view, and one group member commented that the group needed to look at the existing conditions and figure out how they could get to the desired conditions. Sisk indicated that mapping out

the desired conditions and then subtracting those conditions was considerably difficult and not realistic. He explained that the more realistic option was to move towards the desired conditions, using real people and real methods for moving towards finding treatment options and outcomes.

Q: Do you have the time and resources to run both models to see if there is a real wide difference between the initial scenario (based on %) input and the output? Sisk responded by stating that doing so was very time consuming and that it was very difficult to say that they want different basal areas in different places. He stressed that this method was not practical when considering millions of acres. Another group member suggested instead of focusing on percentage, why couldn't the group just say what they wanted the area to look like. Sisk re-iterated that it was not realistic.

The working group members expressed interest in defining treatments that would reduce fire behavior to a particular threshold. Sisk explained that the team could look at a particular area's predicted active crown fire and explore whether it would be possible, given the tools available, to define the percent reduction needed to reduce crowning. He explained that the group was talking about preserving a range, and that this was an expansive, broad vision. He felt that the group needed to work in the broad perspective, but also target what they want things to look like after the target condition.

Logistics for next meeting

Sisk indicated that the team would take into account what has been discussed at the meeting and they would work on developing a "stepping stone" for where the group wants to go. Q: Can you provide one screen with a baseline and another screen with a map with layers that we can overlay and start checking things off to see if we like something? Sisk assured the group that the team could do so. He explained that the baseline will be the current conditions, and that the group could click a box (e.g., MSO habitats) and see how the change looks. He added that it would provide a useful visual for the group.

Romero reminded group members that the next meeting is in Holbrook on September 17. She explained that the group would need to agree about how much they have finished, in order to determine if they would need the optional meeting on Oct. 9 (location to be determined). Romero then asked who was working in small groups. *WUI*: Keith, Steve, Sarah, Ethan, Scott, Brett, and Shaula; *Fire*: Ethan, Todd, Pascal, Steve, and Brett; *Wildlife*: Sarah and Shaula

Public comment period

One audience member spoke to the group about thinking in concepts, and that he had done so with his own team for a previous project. He suggested to the group that they should consider different condition classes and treatment options one-by-one and that they should work on getting themselves closer to agreement one step at a time. He explained that while working on his project, his own team started to think about the treatments they would use to get there, as well as the amount of product that could come

off the land. He stated that by looking at the maps and listening to this group today, he could say that it does work and that it is possible.

Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona

September 17, 2007
9:00 a.m. – 4:15 p.m.
Northland Pioneer College, Holbrook, AZ

9:00 – 9:15 a.m.	Welcome – *Rosemary Romero* (Facilitator, Rosemary Romero Consulting)
9:15 – 9:30 a.m.	Review meeting agenda, timetable and various project updates **–** *Haydee Hampton* (Research Associate, Environmental Sciences, Northern Arizona University)
9:30 – 10:30 a.m.	**Identify areas appropriate for restoration treatments that recover wood byproducts** Review Working Group's efforts to date on identifying areas appropriate for restoration treatments using additive display of map-based scenario components followed by Working Group decision-making session to identify any additional areas **–** *Jill Rundall* (Senior Research Specialist, Environmental Sciences, NAU) *and Haydee Hampton*
10:30 – 10:45 a.m.	Break
10:45 – 12:00 p.m.	**Define management objectives and select treatments** Presentation and group discussion (30 minutes each) on Wildland-Urban Interface (WUI) and Fire small group efforts. Review Working Group draft management objectives and treatments. **–** *Brett Dickson* (Assistant Research Professor, Environmental Sciences, NAU), *Jill Rundall and Haydee Hampton*
12:00 – 1:00 p.m.	Lunch *** Lunch will be on site. Sandwich fixings available for $5 (check or cash only) or bring your own. ***

1:00 – 1:45 p.m.	**Updates on wood estimation and other spatial data** Presentation on methods for developing spatial data on wood volume and for predicting forest growth **–** *Steve Sesnie* (Postdoctoral Research Associate, Environmental Sciences, NAU) Updates on spatial data collection **–** *Jill Rundall*
1:45 – 2:30 p.m.	**Define management objectives and select treatments (cont.)** Working Group decision-making session on the selection of treatments of interest to Working Group **–** *facilitated by Rosemary Romero* Map-based treatments recommended by collaborative groups in the Western Mogollon Plateau Adaptive Landscape Assessment (WMPALA) and the White Mountains Landscape Assessment (WMLA) **–** *Haydee Hampton*
2:30 – 2:45 p.m.	Break
2:45 – 3:45 p.m.	Define management objectives and select treatments (cont.)
3:45 – 4:00 p.m.	**Updates on wood utilization database and logistics for next meeting** Presentation on harvesters, mills and manufacturers in analysis area **–** *Gary Snider* (Forest Economist and Doctoral Candidate, School of Forestry, Northern Arizona University) Group discussion on need for Oct. 9 meeting (location to be announced).
4:00 – 4:15 p.m.	Public comment period
4:15 p.m.	Adjourn

Meeting Summary
Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona
September 17, 2007, Northland Pioneer College, Painted Desert Campus
2251 N. Navajo Blvd., Holbrook, AZ

Introduction and Agenda Review

Rosemary Romero (Meeting Facilitator) welcomed back the working group members and observers to the fourth group meeting. She opened the meeting by having working group and audience members introduce themselves.

***Working Group members present at meeting (in order of presentation)*:**
1) Bill Greenwood, City Manager for the Town of Eagar
2) Molly Pitts, Executive Director of the Northern Arizona Wood Products Association
3) Herb Hopper, Community-based forest and wood products advocate, Little Colorado Plateau Resource Conservation & Development
4) Bob Taylor, Supervisory Natural Resource Specialist for the Apache-Sitgreaves National Forest
5) Steve Gatewood, Consultant, Wildwood Consulting Inc., representing the Greater Flagstaff Forests Partnership
6) Larry Stephenson, Executive Director of the Eastern Arizona Counties Organization (ECO)/Economic Environmental Counties Organization (EECO)
7) Todd Schulke, Forest Programs Director for the Center of Biological Diversity
8) Rob Davis, President/Owner of Forest Energy Corporation/Future Forests
9) Kim Newbauer, Timber Sales Contracting Officer for Coconino National Forest
10) Wally Covington, Director of the ERI and NAU Forestry Department Regents' Professor
11) Shaula Hedwall, Ecological Services, U.S. Fish and Wildlife Service
12) Sarah Lantz, Urban Wildlife Planner for Arizona Game and Fish Department (Region II Flagstaff Office)
13) Lisa McNeilly, Northern Arizona Program Director of The Nature Conservancy
14) Scott Higginson, Executive Vice President of NZ Legacy/Snowflake White Mountain Power, Renergy

***Working Group members not present at meeting*:**
1) Robert LaCapa, Forest Manager, DOI BIA Fort Apache Agency Branch of Forestry
2) Chuck Peone, Fort Apache Timber Co.
3) Paul DeClay, Tribal Forester, Forestry Department, White Mountains Apache Tribe
4) Elaine Zieroth, Forest Supervisor for Apache-Sitgreaves National Forest (alternate present: Bob Taylor)
5) Keith Pajkos, Timber Staff for the Arizona State Lands Department Forestry Division
6) Ethan Aumack, Director of Restoration Programs for Grand Canyon Trust
7) Jerry Drury, Timber Staff Officer for the Kaibab National Forest
8) Pascal Berlioux, President and Chief Executive Officer of Arizona Forest

Restoration Products, Inc.
9) Diane Vosick, Associate Director of the Ecological Restoration Institute (alternate present: Wally Covington)

Meeting observers:
1) Sue Sitko, The Nature Conservancy
2) Penny Pew, Office of Congressman Renzi
3) Bob Baltes, Federal Development
4) David Dorum, AZGFD
5) Ed Martin, SW Forest Products
6) Dave Brewer, ERI

Romero then turned the floor over to Haydee Hampton, the Forest Ecosystem Restoration Analysis (Forest Ecosystem Restoration Analysis; ForestERA) Project Manager leading this collaborative effort.

Haydee Hampton: *Wood Supply Team Introductions and Agenda*
Hampton reviewed the agenda and covered the major points that were to be covered at the meeting. She indicated to group members that she believed the portion of the scenario identifying areas appropriate for restoration treatment could be finished today, and she also told group members that there would be two presentations that were not covered the previous meeting, from ForestERA team members Jill Rundall and Steve Sesnie. She also explained that the agenda provided 2 hours for the group to define additional management objectives.

Hampton then discussed details about the remaining timetable for the working group:

September 17: Revise treatment scenarios and discuss treatment characterization and preliminary results of forest growth review.

Hampton informed group members that the wood user database scheduled for Oct 15 would be moved up to be discussed at this meeting by Gary Snider. She also told group members that they would need to decide whether or not they need the Oct 9 meeting.

October 15: Finalize treatment scenario; review draft wood volume layer and wood use database; decide on need for Oct 29 meeting.

November 16: Discuss wood supply results; discuss potential economic or other follow-up analyses - December 1st for final deliverables.

Hampton reported to group members that they should have received the Wood Supply Analysis Progress Report. She also indicated that the ForestERA team would like to receive comments from the working group by Thursday, September 27, 2007. She then mentioned that Region 3 Directors viewed the progress report and some had some questions and comments. Regarding the time frame of study:
- The ForestERA team is estimating current wood supply for a snapshot in time. The “ad hoc” committee which initiated this study recommended that any projections on current conditions be conducted within a 20 year time frame. She indicated that the team was presenting initial growth estimates for this period.
- A Region 3 director commented that re-entry is highly unlikely within a 20 year period.

- She also told group members that decisions about prioritizing treatments, assumption on acres treated/yr could be included in the report.

Hampton reviewed comments ForestERA had received after the last meeting regarding the use of FRCC LandFire data. Linda Wadleigh, Region 3 Fire Ecologist, who ForestERA staff had met with after the Sept. 17 working group meeting, indicated that the National Level LandFire FRCC layer was due out soon, but was not yet available and that she would not recommend using the Rapid Assessment LandFire FRCC layer that is available.

Hampton pointed out that the landscape level treatment characterizations used in this study will allow the estimation of wood supply, while detailed prescriptions will involve public interaction at a local level. She then referred the working group to the letter they had requested at the June 4 working group meeting from Harv Forsgren (Region 3 Forest Supervisor) which pointed out that results from this study would be useful for local level discussions. Hampton continued her session by explaining that no wood byproducts would result from burn only treatments, so in effect they would be excluded from the scenarios similar to the decision made about steep slopes. To this, one working group member commented that the use of heavy burn treatment will kill trees that could be use for salvage logging (and biomass as well pointed out another member), and we should explicitly state in the final report that we're not including these as available wood supply in the study.

Hampton then presented a slide about the potential number of treatment scenarios developed by the working group. She explained that it was up the working group to decide how many scenarios of which type would result from this process as it unfolded.
She explained that there were several possibilities:

- One agreed upon scenario
- More than one on which there is agreement
- More than one showing various levels of agreement
- More than one showing a mix

She then reviewed a slide about treatment prioritization and indicated that the ForestERA team needed input (about priority areas – for sequencing treatments) by the end of the October 15th meeting to have sufficient time to include this type of analysis in this study. She also mentioned that this was not a required part of the wood supply analysis. Hampton then continued her segment by discussing that there were at least two methods for prioritizing areas in need of management attention. The first was the identification of values at risk that collaborative groups had used at the previous landscape assessments in the area. She also reviewed the Treatment Optimization Modeling (TOM) that Brett Dickson presented at the July 18th working group meeting, and one straw man plan for using it to prioritize treatment locations together with values at risk:

- Develop layer showing potential treatments
- Run TOM to select optimal treatment locations (e.g., 10 or 20% of total area)
- Develop layer of priority areas across analysis area using values at risk method

- Use values at risk prioritization process to provide preferred sequencing of treatments within TOM areas

Q: How would the approved Community Wildfire Protection Plans (CWPPs) fit into this? Hampton responded that the working group could handle this in several ways. At this point, one working group member explained that her WUI small group's talk fits into the where and when, as well as the treatment types, as far as prioritizations go. Another group member commented that they thought the prioritization might change, and they didn't believe the working group should go this route. Hampton explained that the working group could set out a specific time to discuss this topic. Romero suggested that the group could possibly do that after the presentations.

Hampton continued by saying that ForestERA was working together with working group members representing the White Mountain Apache tribe to develop methods and access to data to estimate reservation-wide wood volumes. She then commented that this had been identified by the Steering committee and others as important since there were significant volumes of ponderosa pines on the Mogollon Plateau located on reservation land.

Hampton moved onto a slide about identifying areas appropriate for restoration treatments that recover wood byproducts. She then outlined those areas that had been excluded by the layers:

- Initial acreage of ponderosa pine area = 2,030,195
- MSO – acres removed = 142,089; acres remaining = 1,888,106
- MSO,SDA – acres removed = 91,293; acres remaining = 1,796,813
- MSO,SDA, Slope – acres removed = 38,142; acres remaining = 1,758,671
- MSO,SDA, Slope, Soil with limited mechanized treatments – acres removed = 45,259; acres remaining = 1,713,412

Q: When you found 16% of the study area ponderosa pine removed, did you include areas of overlap? Hampton responded that the team counted areas only once, even if more than one factor (e.g., slopes and MSO PACs) occurred in the same location.

In addition to this information, Brett Dickson acknowledged that there might be a few PAC's missing from the A-S analysis, and a working group member commented that they didn't think it would be a significant portion of the PAC's. Hampton indicated that the group could come back to this slide and went ahead to the soil issue. She presented a slide with information about soils with mechanized equipment limitations

- Completed collection of soil information from four forests in analysis area
- ForestERA team members are checking back with soil scientists before finalizing layer
- Limitations based on a number of factors, including areas:
    - with erosion hazard
    - with shallow soils
    - with high rock content
    - prone to sheet and rill erosion once ground cover gets thin
    - prone to compaction when wet (secondary factor)

At this time, she referred to Dave Brewer about the soil survey information. He explained that the terrestrial soil survey data is useful because it is quite relevant for broad-based planning. He indicated that there are several good things about the soil survey including that the data goes through a detailed review process.

Hampton responded that the ForestERA team would continue working with soil scientists and refine the draft and then get back to the working group.
Q: You'll bring that back to us for recommendation, right? Hampton answered that the ForestERA team can do that.
Q: Can't soil damage be mitigated on the areas you have mapped? Brewer answered this by stating that some damage to sensitive soils areas can be mitigated, but that only the areas that were too difficult to mitigate damage from mechanized equipment were shown on the maps. Areas that could be mitigated were not included.

Hampton then moved forward with discussing completed and contracted (sold) treatments to check in with the group on how they were planning to proceed. She included several related points in her slide:

- Applies to treatments post-dating the remote-sensing imagery used to develop forest structure maps used in this process.
- For treatments with "exact" boundary information
  - Remove areas with intermediate and high intensity thinning treatments from scenario
  - Wood byproducts are assumed not available from these areas
- Include areas with light thinning or unknown treatment intensity in scenario
  - Wood byproducts are available from these areas

Hampton also commented that for areas in which treatment intensity data and boundary data do not exist (e.g., only stand exam data exists), the ForestERA team will account for these acres by adjusting analysis area wide volume and supply estimates.

Q: As far as your imagery dating, does that vary across the board? Hampton indicated that it does, and that the imagery acquisition dates ranged from 1997 to 2004.

Jill Rundall and Haydee Hampton: *Identify areas appropriate for restoration treatments that recover wood byproducts.*
Rundall indicated that she met with the different forests to discuss the areas with thinning treatments. She provided estimates about these areas, but acknowledged that some of the acres may have been treated more than once:

- Kaibab (1997-2006) 19,817
- Apache-Sitgreaves (1997-2007) Pending
- Tonto (2001-2007) 10,906
- Coconino (n/a) Pending

Rundall then presented a map of the Kaibab and Tonto treatment areas that she had made from data she had collected.
Q: So that 7,000 acres that you referred to do not include other forest areas? Rundall confirmed that they did not include non-ponderosa pine areas.

Hampton then went on to discuss the treatment guidelines for streamside management zones. She indicated that the team decided against carrying out a detailed analysis for several reasons. She indicated that there is a lack of finalized data for ADEQ's "unique" or "impaired" waters and the current version identifies few streams. Also, the ESA fish data are incomplete. She also presented that the ASNF is the only forest that precludes mechanized equipment from areas next to streams. The other Forests specify BMPs to mitigate damage, but no rules that specifically restrict equipment from these areas.
Q: Would it be useful to get an estimated percentage for what would be removed? Hampton commented that the Forest Service hydrologist on the ASNF was not able to give her a guesstimate, not even a ballpark number like 1% or 5%. One group member said that they had a feeling that when you take the steep slope out, streamside management zones wouldn't add very much. Another group member suggested doing a quick analysis by buffering streams throughout the study area by 100 feet, in order to gain a better understanding. Other group members agreed with applying this buffer to develop an estimate of streamside management zones. Hampton agreed that ForestERA would develop a layer of buffered streams to present to the group at the next meeting.

Hampton then returned to the areas removed from the group's scenario. She said the overlap among the layers was about 27% (119,242 acres). The total acres (considering overlap) were equivalent to about 324,105 acres.
Q: Does the overlap include the Clifton ranger district as well? Rundall answered that it only includes ponderosa pine areas, which are not prevalent on the Clifton RD.

Hampton moved onto discussing a last slide that included information about the Woody Ridge and other forest restoration projects reviewed for acres treated within the NEPA planning area. She indicated that the team found 2/3 of the areas had been thinned. She explained that 66% of Woody Ridge had been thinned, while Jerry Drury had conducted a study on the Kaibab NF and found that about 62% of areas were thinned.

Gary Snider commented that he was talking with Drury about how they got to the number 66%. Snider then referred to Kim Newbauer, and he indicated that the numbers included the areas he could think of. Hampton iterated that the idea here is to look at the project level to compare to the landscape level analysis being done for this analysis of wood supply. She expressed that this information could be used as a benchmark and it includes archeological sites and other factors that cannot be mapped out.

One group member commented that they felt the need for a more careful look at this. They indicated that on the Gila, they end up thinning more like 30-40% of the area, and that is dramatically less than 60%. This group member added that there's a pretty strong WUI objective that could possibly have an influence, and they also felt that it's a pretty important objective to address and decide how the group will deal with it. Another group member commented that they

would be reluctant to take a number and do anything, because the group needed to do an analysis instead, and get some numbers and ranges – instead of taking that 66% across the board. Romero suggested that the group could make sure to include a list of these factors in the report, as was mentioned by someone before. At this point, a group member commented that the group should not use a gross number that is not reality on the ground; they wanted the group to be very clear as to what the reality is that is done on the project level. To this, another group member commented that the working group has been talking about 6 factors today, but that they have other factors in their notes. This member wanted to clarify that the group wasn't saying only 16% is being taken off the map.
Q: We're not finalizing it at 16%; there are other factors, right? Hampton agreed that the working group could decide to add other factors as well.

One group member expressed that one of the things the group previously talked about was getting a supply estimate and a volume estimate. This group member explained that the group needed to think about the volume that is there and what will come out and how that will affect the supply. One group member responded that they thought the working group should account for northern goshawk nests. They suggested excluding 30-50 acres around goshawk nesting sites from sources of supply. Romero found that the group was in agreement on this issue and Hampton commented that ForestERA could map these areas and include them as additional acres removed. One group member thought that this data would provide a floor for the nesting treatments. Another group member felt that the group should pull out the areas where there is not treatment. Another group member explained that although it's a small number of thousands, when considering 30 acres for each nesting site it becomes more significant.

Define management objectives and select treatments

Working group member, Sarah Lantz, explained that a small group met the week before to discuss the WUI and some various approaches, and she indicated that they would present some mapping exercises that the working group could use to share some ideas. The small group was trying to depict areas of highest priority for community protection to guide decision-making. Lantz indicated that each CWPP (Flagstaff, Tusayan, Williams, Mogollon Rim, Apache and Sitgreaves) had extremely variable definitions for indicating the priority areas and these did not cover the entire study area. However, the small group was able to come up with several proposed options:

1. Place ¼ mile buffers around private lands
2. Only include areas that the CWPPs identified as being high priority
3. Place a wind-vector of ½ mile downwind and 1½ miles upwind of private lands. This is related somewhat to HFRA definitions.
4. Place a wind-vector of ½ mile downwind and 1½ miles upwind of private lands within CWPP high priority areas and ¼ mile buffers around private lands outside of CWPP areas.

After consideration, the last proposal option was the most widely agreed upon. One working group member commented there were some other factors that weren't figured into the small group's analysis, such as power line corridors, etc. Lantz explained that the small group included several political, social, and scientific considerations.

Q: What was the thinking in option 4? Why expand CWPP areas by adding on the buffer zones? Lantz explained that adding the buffer zones doesn't expand it; instead it really helps to narrow it down. One group member responded that the working group needed to be careful when addressing this issue in the report. This member indicated that, "CWPPs actually redefine the WUI for their community. We are taking their priority areas and applying this buffer – we might not want to label this as WUI."
Q: What designates an area as priority in a CWPP? Lantz explained that each CWPP is different. One group member expressed their agreement with a previous comment about municipal watersheds and power lines. This person felt that the working group should be diligent to address and consider such issues at some point. Another group member mentioned that the group was defining a heavier treatment, not prioritizing the treatment. Lantz agreed and said that, "This doesn't say that this area gets heavier treatment than other ones; that's for the group to decide." To this, one group member included that the small group was showing treatment in their map that the working group decided to exclude (around the Blue River). Lantz affirmed that those areas would remain excluded in the working group's scenario.

Working group member, Steve Gatewood, then presented the "fire" small group's discussion results. Gatewood explained that the small group had talked about fire, specifically about which areas might be taken out of consideration as sources of supply because they had been potentially treated using fire only. He indicated that the small group made the suggestion that wood be utilized when possible instead of burning it in piles, and that the small group wanted to talk about fire as a tool (e.g., broadcast burning). Gatewood further explained that output from the Landfire/FlamMap models included surface, passive crown fire, and active crown fire, but that this did not account for fire spread; it only refers to the fire behavior that would occur in a pixel if that area was ignited. He commented that the small group had Brett Dickson do a 500-acre analysis where Dickson would group pixels and apply a fire behavior level to the 500-acre block. He assured members that this was not a fire spread model.

Gatewood continued his discussion by referring to the second example on the small group's worksheet. He explained that that issue was really their "straw man". Gatewood commented that using FlamMap-generated data for the study area identifies patches characterized by predicted surface fire, passive crown fire, and active crown fire; He added that the group determined surface fire–dominated patches to be "areas where prescribed burning and/or wildland fire use [WFU] are likely to be a preferred first management". Then, he explained that the group identified active crown fire–dominated patches as "areas where prescribed burning and/or WFU are unlikely to be a preferred first management approach". Lastly, Gatewood added that the group identified patches largely contained within high priority community protection zones as "areas where prescribed burning and/or WFU are unlikely to be preferred first management approach".

Q: Are you running the models assuming a 95th percentile weather scenario? Dickson explained that this is a work in progress, and that the ForestERA team can run the model using various weather scenarios.
Q: If you're going back into these areas and burning after mechanical treatment, why would we prioritize these areas? Gatewood responded that currently the Forest Service operates with this because fire is the cheapest option. One group member commented that the working group is

basing this decision on budget constraints and lack of industry constraints. Gatewood responded by saying that he believes a previous working group member indicated that the group should do as much burning as possible where feasible to avoid potential negative impacts of mechanical treatment. He added that there was a desire to use fire where it can be used, even if there is supply there. Another group member explained that this is the policy preference of several organizations represented by the Working Group. Another member added that these are policy preferences that are based upon assumptions, and that these aren't really documented.

Another group member indicated that they had a high level of discomfort with using FlamMap outputs to determine those areas where fire only treatments are appropriate just because they are identified as such on this map. One group member added that there is a strong opinion for an approach where fire can be used as the primary restoration tool. They felt that the perspective of using fire wherever possible is something that this group should be sure to discuss. In response, a group member explained that if this model was torn apart pixel by pixel, the group would not be able to see what happens when fire is the first option and mechanical treatment could be used too.
Q: Has there been any effort to work with the individual forests to see if they would agree that these models are dependable? Dickson explained that LandFire is holding a meeting in Albuquerque, in which experts on the ground would look at the same models the team was using here and they would decide if they agree with the models. One group member felt that the working group had to think about something a bit smaller than the 500-acre fire unit.
Q: Is this model part of the next step to put a fire-spread overlay? Again, Dickson responded, saying that all the team did was impose a small fire spread effect, being very conservative; they then went through the 500-acre exercise based on the assumptions of the model.

Romero then commented that fire only treatment group still had some work to do for the next meeting, and she iterated that the group had to come back to the WUI discussion.
Q: Can the small groups create summary documents and then hand them out to working group members? The small group leaders responded that they could do this.

Romero began the second half of the meeting by providing additional information about the remaining meetings:

October 9th meeting (if it takes place) will be in **Holbrook**;
October 15th meeting in **Pinetop**;
October 29th meeting (if it takes place) will be in **Flagstaff**;
November 16th meeting in **Flagstaff**.

Steve Sesnie: *Wood volume estimation*
Sesnie began by discussing the forest growth and volume estimates for ponderosa pine forest type. He explained that his base set of plots came from the Forest Inventory and Analysis (FIA) PIPO type, which equals 327 plots. He also indicated that the plots were measured in the mid 90's, and that he would grow the plots to reflect conditions now and 20 years from now.

Sesnie then presented a set of average forest condition graphs, using a base set of information from FIA, outlining the 2007 and 2027 data from forest vegetation in the southwest United States.
Q: Does this model reflect regeneration? Sesnie indicated that he could add that to these model runs, but added that he didn't think the volume estimates would change that much. Q: Are you going to let us see what that equates to in 2027? Sesnie explained that that would require the team to grow the information forward by pixel; he added that he hasn't thought about how to do that yet.
Q: Can't you put the treatment data into that then? Sesnie affirmed that the team could do that. He explained that they could take an average plot condition and apply the treatment condition to it and see what that area will look like in 20 years. He also added that they would need another model to estimate forest growth pixel by pixel across the entire landscape.
Q: Is the 2007 baseline here our map? Sesnie responded by saying that it will be the date of imagery that was recorded in 2004. One group member commented that the data were based on the FIA plot, which is 1 plot per 6,000 acres, so it's not a very strong representation.

Sesnie also included a graph showing forest growth for 2007 and 2027. He explained that the small diameter volume made up about 30% for 2007 and 24% for 2027; small diameter basal area was 54% for 2007, while it was 36% for 2027. He warned the group that they should be careful about estimating the volume ranges because there is greater error associated with measuring narrower diameter classes. He then confirmed that he would take the FIA data and estimate forest volume across the ponderosa pine forest type, using a regression modeling approach. He presented this as a three-step process:

- FIA plots – reference data by volume class
- Data layers – CC, QMD, BA, TPA, biophysical variables (elevations)
- Error estimation – root mean square difference from observed and imputed variables

Q: What are other biophysical variables? Sesnie answered that these could include precipitation and other climate data.
Q: What about site indexes? Sesnie answered that the data could include site indices to estimate how growth behavior looks in the future.
Q: Have you decided what you will settle on in diameter size class? Sesnie explained that the team considered having a diameter range between 5-12 inches, 12 and above, and 5 and below. He added that he discussed this issue with John Bailey, a professor at Oregon State, who used to be at NAU and has a strong silvicultural background in ponderosa pine forests, who is involved in the project and together they thought that the break-point should be around 5 and 12 inches. Hampton added that they also reviewed the diameter class breaks recommended by the working group at the meeting with Bailey.

Sesnie's final slide looked at tree mortality and disturbance factors affecting volume estimates:

- Forest insect outbreaks
- Fire perimeter (BAER data)
- Fire severity
- Drought killed trees

Sesnie then commented that the first reason he used the growth model was to get the data points up-to-date. He explained that it does help give everyone an estimate of how much volume estimate can be expected at a given time. He added that density and site conditions are really what drive growth, so there is potential to estimate volume in that way.
Q: Is there a limit to the independent variables? Sesnie explained that other IV's could be added to the model, but that they likely wouldn't contribute to the accuracy of what he was doing. Sesnie then added that the team was planning on doing an independent assessment of the volume estimates.

Jill Rundall: *Updates on spatial data collection*
Rundall began her segment by reviewing a table summarizing spatial layers that the ForestERA team was almost finished acquiring. She continued with discussing the background information on roads and she referred to Chris Bielecki, ASNF Transportation Engineer, who suggests the group consider using a layer based on distance from arterial roads (i.e., roads already suitable for mechanized equipment). Rundall then presented a slide that represented the distance from system or arterial roads. Hampton reiterated that Bielecki had suggested that the layer might be useful to the working group in lieu of a complete roads layer which does not exist. She added that the information presented was in response to what the group wanted from last meeting. One group member commented that they didn't think the system road layer was useful because there weren't enough roads represented that will be used to harvest small-diameter material. This group member added that there are too few roads that are represented. Why don't we have better roads layer for the Forests when they are going through a Travel Management process? Another group member commented that [from A-S standpoint], there are about 3,000 miles of road that are not in the mapped data system; about 6,000 miles are in the system; only 2,000 of those are knowingly being used. This group member agreed with a previous comment that the distance from system roads layer was not valuable for the group's work. Rundall then showed the group a layer with both system and non-system Forest Service roads – the complete roads data set from the Forest Service. She commented that the layer was missing data for classes 1 and 2. A group member explained that Class 1 are closed roads and Class 2 are maintained roads.
Q: Can you characterize these roads? Rundall responded by saying that they were presenting the current data from the FS road system that is in their database. One group member commented that there are 3,000 miles of roads that are not logged into the system.
Q: Can we get the roads layer from the Coconino NF stemming from the Travel management process? Rundall confirmed that they will ask for this.

Next, Brett Dickson discussed information from treatment alternative worksheet given to working group members. He commented that the table included additional information that was recently developed with professor Bailey, and he then opened the floor for discussion about what was included in the table.
Q: Could you explain the numbers in the categories? Dickson explained that those are the stem reduction values, which were drawn from research and expert opinion.
Q: What is the thinning effort that has gone on around Forest Lakes? One group member commented that that would be the intermediate level – about a 60% reduction in stand density and 40% basal area.
Q: What's a sufficient large-tree component? Dickson iterated that *sufficient* refers to the need for a large tree component for the area to be restored in one entry. One group member

commented that they needed to work on the language to make it more usable for the working group. Dickson confirmed that the team could change the language for the working group.
Q: How do you define where you use these treatments? Can't we just start at existing conditions? Hampton explained that other groups have done that (i.e., in the White Mountain Landscape Assessment). She added that groups have specified ranges of forest structure metrics, such as, place thinning treatments where stem density >200 stems/acre. Hampton then presented several management objectives that previous groups had used:

- Reduce the risk of high intensity crown fires throughout study area
- Prioritize treatments in areas of highest risk for large fires and place higher intensity treatments where fires were predicted to burn more intensely.
- Protect and enhance habitat for endangered species, and minimize treatment impacts
- Treat areas upwind of Mexican spotted owl PAC's and excluded treatments within them
- Restore grasslands
- Select mollisol soil areas as indicators of historic grasslands
- Increase the quality and extent of special habitats, such as aspen stands and pine-oak woodlands
- Remove ponderosa pine from riparian systems and aspen stands

Q: As a group, can we have a discussion about defining a dozen desired conditions and figure out where to apply them? One group member proposed another approach - have a model of fire spread and risk that would define the treatments. Another group member explained that this approach could work from a fire management position, but not from a restoration position.
Q: Do you have information about the total volume that is on the forest floor today? Sesnie explained that the team didn't at this time but they plan hope to by next month.
Q: Can you aggregate areas into 100-acre sections? Sesnie confirmed that they could do this, but that the team needed to think of a size that was manageable.

Romero then asked the working group how they felt about the table. One group member commented that they were uncomfortable with the language. Several other group members claimed that they needed to define desired future conditions (DFC) first. Another group member added that they thought people wanted to see the forest structural attributes written in residual units instead of percent reduction. Hampton responded to this by stating that this could easily be done.

Haydee Hampton: *Define management objectives and select treatments (cont.)*
Hampton began the last part of the meeting by recording on screen the working group discussion they requested before the break on desired future conditions. One group member suggested finishing the WUI discussion first. Another responded by saying that the group should choose one of the WUI options. The working group decided to go with the fourth option presented by the WUI small group earlier in the day:

- WUI definition: Place a wind-vector of ½ mile downwind and 1½ miles upwind of private lands within CWPP high priority areas and ¼ mile buffers around private lands outside of CWPP areas.

The group discussed the following objectives that have desired future conditions (one member commented that the group should decide what to do in the WUI at this meeting. What are the desired post-treatment conditions in these areas?):

- Follow goshawk guidelines to reach VSS class targets in terms of % basal area (one member commented that the guidelines specify percentages for area covered, not basal area. Another commented that these are more appropriate to apply at project level)

VSS 1-2	3	4	5	6
20%	20%	20%	20%	20%

- Wildlands
  - Objective: Apply heavy thinning to predicted crown fire areas; apply moderate thinning to passive crown fire areas
  - DFCs based on pre-settlement conditions: BA: 40-60 ft^2/acre and stem density: 30-70 trees/acre
- WUI
  - Objective: Reduce fire behavior to surface fire based on 500 acre patch size in WUI areas.
  - Several group members recommended that more extreme weather conditions (97^{th} percentile instead of 95^{th}) be used to predict fire behavior in the WUI to reflect the lower tolerance for fire risk in these areas. One member requested 99^{th} percentile in the WUI.
- MSO PACs and restricted habitat
  - Apply 1.5 to 3 miles upwind buffer of packs or blocks of packs where intensive treatment buffer is needed. Discussion ensued that there are better ways to protect MSO habitat that using upwind vectors and the group agreed to explore these.
  - Base on MSO Recovery Plan threshold target habitat.

One group member commented that the goshawk VSS classes apply to fine-scaled project level considerations. Instead, they suggested that the group go back to the management objectives, because looking at desired future conditions would be too difficult. Several group members briefly discussed the issue of current forest structure and what is desired. One member recommended the group could determine a DFC in terms of how many tons could be removed; several group members commented that they would find it difficult to think about desired future conditions in terms of tons (several members concurred). The group then reviewed their draft treatment scenario worksheet on screen. One group member explained that the working group needed some ideas from the team to review next meeting and react to, in order to say that they agree or disagree with those ideas. Specifically, one member of the group commented that we'd like to tease out of the fire behavior models which have inputs of crown bulk density and other attributes, conditions in terms of basal area, tree density and canopy cover. Right now we can define the conditions we'd like and later we can assign forest structure values to them.

Several group members suggested that another group should be established, a "scenario attribute" group. A group member suggested having Shaula, someone from ERI and someone from Forest Service in the group. Hampton commented that the ForestERA team could pull this small group together but recommends they meet earlier than later to allow more time to pull map-based results together before the next meeting. Romero helped the group to select a date for

the fire and scenario attribute groups to meet: Fire group – 9/27 (10-12pm); Scenario attribute group – 9/27 (1-3pm).

Audience comments
Bob Maltis commented that today was the first time that he heard that people considered fire only as a restoration treatment. He explained that he could get data from ear, nose and throat doctors related to the effects of smoke billowing through Prescott. He added that he could have that information available. Romero suggested that he provide the working group with that information in the form of a handout. Maltis agreed to get information to Hampton for the next meeting.

Gary Snider: *Updates on wood utilization database*
Snider summarized his work to date identifying wood harvesters, mills and manufacturers in the study area and quantifying the number of tons of material processed by each. He told group members that he talked with various contractors in the western Mogollon area at length. He indicated that virtually all of the wood was sent to SW Forest Products in 2006. He also included information about the White Mountains area, which included contractors like Walker Bros., Nutrioso Logging, and Tri Star Logging. He explained that this was wood coming out of National Forest lands, but not off reservation land.

Logistics
Romero asked the group if they wanted to meet on October 9th. One group member commented that they were not convinced that working group members could meet in small groups and make progress before Oct 9th. They suggested meeting next on the already scheduled date of October 15th instead. Other group members agreed and added that the Oct 29th meeting was likely to be mandatory, however no final decision was made on this date.
Q: Can we get handouts soon from the small groups? YES – the groups (WUI group and fire group) indicated they would distribute handouts by the end of the week.

Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona

October 15, 2007
9:00 a.m. – 4:15 p.m.
Arizona Game and Fish Department Regional Office, Pinetop, AZ

9:00 – 9:15 a.m.	Welcome – *Rosemary Romero* (Facilitator, Rosemary Romero Consulting)
9:15 – 9:30 a.m.	Review meeting agenda, timetable and various project updates **–** *Haydee Hampton* (Research Associate, Environmental Sciences, Northern Arizona University)
9:30 – 10:30 a.m.	**Identify areas appropriate for restoration treatments that recover wood byproducts** Review Working Group's efforts to date on identifying areas appropriate for restoration treatments using additive display of map-based scenario components followed by Working Group decision-making session to identify any additional areas, such as areas next to streams, with no road access, or having soils with mechanized equipment limitations **–** *Jill Rundall* (Senior Research Specialist, Environmental Sciences, NAU) *and Haydee Hampton* Updates on spatial data collection **–** *Jill Rundall*
10:30 – 10:45 a.m.	Break
10:45 – 12:00 p.m.	**Define management objectives and select treatments** Presentation and group discussion on Scenario Attribute small group efforts by *volunteer from group* (up to 45 minutes) and report back on Fire small group efforts (up to 30 minutes) by *Brett Dickson* (Assistant Research Professor, Environmental Sciences, NAU), with spatial data support by *Jill Rundall and Haydee Hampton*

12:00 – 1:00 p.m.	Lunch
	*** Lunch will be on site. Working group can order sandwiches before 9am for ~$7 (check or cash only) or bring their own. ***
1:00 – 2:30 p.m.	**Define management objectives and select treatments (cont.)**
	Landscape-level treatment characterizations **–** *Steve Sesnie*
	Working Group decision-making session on the selection of management objectives and treatments of interest to Working Group **–** *facilitated by Rosemary Romero*
2:30 – 2:45 p.m.	Break
2:45 – 3:30 p.m.	**Define management objectives and select treatments (cont.)**
3:30 – 4:00 p.m.	**Parking lot items and logistics for next meeting**
	Discuss parking lot items, if not covered earlier in day: Community Wildfire Protection Plans (CWPPs), Stewardship Contracts, White Mountain Apache reservation-wide volume estimates, salvage logging, and prioritization to sequence potential treatments.
	Group discussion on need for Oct. 29 meeting (in Flagstaff).
4:00 – 4:15 p.m.	Public comment period
4:15 p.m.	Adjourn

Meeting Summary
Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona
October 15, 2007, Arizona Game and Fish Department Regional Office
2878 E. White Mtn. Blvd., Pinetop, AZ

Introduction and Agenda Review
Rosemary Romero (Meeting Facilitator, Romero Consulting) welcomed back the working group members and observers to the fifth group meeting. She opened the meeting by having working group and audience members introduce themselves.

***Working Group members present at meeting*:**
1) Bill Greenwood, City Manager for the Town of Eagar
2) Robert LaCapa, Forest Manager, DOI BIA Fort Apache Agency Branch of Forestry
3) Herb Hopper, Community-based forest and wood products advocate, Little Colorado Plateau Resource Conservation & Development
4) Elaine Zieroth, Forest Supervisor for Apache-Sitgreaves National Forest
5) Ethan Aumack, Director of Restoration Programs for Grand Canyon Trust
6) Steve Gatewood, Consultant, Wildwood Consulting Inc., representing the Greater Flagstaff Forests Partnership
7) Todd Schulke, Forest Programs Director for the Center of Biological Diversity
8) Rob Davis, President/Owner of Forest Energy Corporation/Future Forests
9) Kim Newbauer, Timber Sales Contracting Officer for Coconino National Forest
10) Jerry Drury, Timber Staff Officer for the Kaibab National Forest
11) Sue Sitko, The Nature Conservancy (sitting in for Lisa McNeilly)
12) Sarah Lantz, Urban Wildlife Planner for Arizona Game and Fish Department (Region II Flagstaff Office)
13) Scott Higginson, Executive Vice President of NZ Legacy/Snowflake White Mountain Power, Renergy
14) Pascal Berlioux, President and Chief Executive Officer of Arizona Forest Restoration Products, Inc.
15) Diane Vosick, Associate Director of the Ecological Restoration Institute

***Working Group members not present at meeting*:**
1) Molly Pitts, Executive Director of the Northern Arizona Wood Products Association
2) Larry Stephenson, Executive Director of the Eastern Arizona Counties Organization (ECO)/Economic Environmental Counties Organization (EECO)
3) Chuck Peone, Fort Apache Timber Co.
4) Lisa McNeilly, Northern Arizona Program Director of The Nature Conservancy (alternate attended)
5) Paul DeClay, Tribal Forester, Forestry Department, White Mountains Apache Tribe
6) Keith Pajkos, Timber Staff for the Arizona State Lands Department Forestry Division
7) Shaula Hedwall, Ecological Services, U.S. Fish and Wildlife Service

Meeting observers:
1) Chris Bielecki, Apache-Sitgreaves National Forest (supplied expert input)
2) Bob Baltes, Baltes Distributed Generation
3) McKinley-Ben Miller, BLM
4) Wally Covington, ERI (supplied expert input)
5) Mike Cooley, Cooley Industries, Inc.
6) Dwayne Walker, Future Forests
7) Jim Pitts, Apache-Sitgreaves National Forest, Springerville Ranger District

Romero then turned the floor over to Haydee Hampton (Research Associate, Forest Ecosystem Restoration Analysis; ForestERA) who is leading this collaborative effort.

Haydee Hampton: *Wood Supply Team Introductions and Agenda*
Hampton reviewed the agenda and covered the major points that were to be covered at the meeting. She indicated to group members that they would be reviewing a draft treatment scenario developed by the scenario attribute subcommittee and that she encouraged the group to complete their scenario that day. She also told group members that there would be a brief presentation by Steve Sesnie (Postdoctoral Research Associate, Environmental Sciences, NAU) on landscape-level treatment characterizations.

Hampton then discussed details about the remaining timetable for the working group:
Oct 15: Finalize treatment scenario and review draft layers representing various components of scenario. Decide on need for optional meeting on Oct. 29 (or in November).
Nov 16: Discuss wood supply results and potential economic or other follow-on analyses.

Hampton gave important project updates such as ForestERA's acquisition of new FIA and satellite imagery and how those will be used to up-date the analysis to the 2006 time period (see meeting slides posted at: http://www.forestera.nau.edu/project_woodsupply_documents.htm. This update will require ForestERA to focus on the analytical effort to have the new data processed with the goal to present scenario results at the Nov. 16th date.

Hampton thanked those who provided comments on the Wood Supply Analysis Progress Report and announced to group members that they should have received an electronic version and that hard copies were available at the meeting. She then reviewed some of the comments received on the progress report:

- Make clear closer to start that focus is on mechanical treatments.
- ASNF has found that 40-50% of acres are not thinned within NEPA project areas (versus lower range of 30-40% found on western Mogollon Plateau).
- To avoid NEPA/FACA issues, change wording to "potential treatments" and don't get too prescriptive.
  - Landscape level treatment characterizations allow the estimation of wood supply, while detailed prescriptions will involve public interaction at a local level.
- Local businesses will have access to materials. Forest Service will not supplant existing contracts (Forsgren letter to Steve Sesnie, 7/19/07. *This document was provided as a handout*).
- How should the White Mountains Stewardship Contracts be accounted for over the next 7 years?

  - Removals should include task orders in next 2-3 years as these acres are committed in contracts
- Include updated scenario worksheet and other materials
  - Decided to keep Sept. 7 timestamp on materials.

Steve Gatewood then discussed stewardship contracts and the timing and scale of these. New contracts will be focused on both large and small-scale contractors. Hampton then reminded the group that at the September working group meeting in Holbrook, she had announced that in order to have time to develop and report back to the group on priority areas (for sequencing treatments), ForestERA would need their input by the end of the today's meeting. She explained that this was not a required part of the Wood Supply Analysis and the Steering Committee recommended completing the treatment scenario first, so there was not likely not time to complete a prioritization analysis as part of this project.

Hampton ended the introductory presentation by providing background information on the goshawk guidelines. She explained that the goshawk guidelines dictate management actions in all forest land outside of Mexican spotted owl or other federally listed species habitat. In 1996, the Southwestern Region of the Forest Service (FS) amended all its forest plans based on the recommendations in GTR-RM-217 (published in 1992), "Management Recommendations for the Northern Goshawk in the Southwestern United States," (the "goshawk guidelines"). Clarifications to the 1992 guidelines were made after the FS observed some inconsistency and confusion associated with the implementation of the standards. Hampton explained that ForestERA is acquiring pre- and post-treatment data on treatments marked or completed using the clarification to the guidelines:

- Demo plots in Pine Hill timber sale, Williams RD (have data in hand)
- Eager South (trying to obtain)
- North Kaibab RD

She explained that at the request of the scenario attribute small group members that she had contacted Jim Youtz, Regional Silviculturist, USDA Forest Service, for a recommendation on how to address the goshawk guidelines in the wood supply analysis. A participant commented that all treatments have been implemented under the guidelines over the past several years. Another that many treatments have sided more on the fuels reduction side in some locations.

Hampton continued by saying that she and Sesnie would be traveling to Whiteriver, AZ, on the White Mountains Apache reservation the following day to talk to a planning board on whether it would be possible to obtain data ForestERA could use to estimate reservation-wide small-diameter wood volumes or direct estimates of wood volumes that the tribe had completed in the past. She then commented that this had been identified by the Steering committee and others as important since there were significant volumes of ponderosa pines on the Mogollon Plateau located on reservation land.

Jill Rundall and Haydee Hampton: *Identify areas appropriate for restoration treatments that recover wood byproducts.*

The meeting session on identifying areas appropriate for restoration treatments that recover wood byproducts began with a slide on which Hampton explained that ForestERA had completed checking back with soil scientists on the soil information from four Forests in analysis area on

restrictions placed on using mechanized harvesting equipment based on a number of factors including:

- Erosion hazard
- Shallow soils
- High rock content
- Prone to sheet and rill erosion once ground cover gets thin
- Prone to compaction when wet (secondary factor)

Hampton explained that they had reviewed assumptions used to develop a spatial layer of areas with soils restricted from mechanized equipment with Dr. Steve Hart, Professor, Ecosystem Ecology and Forest Soils, Northern Arizona University and that he had expressed confidence in using the interpretive summaries (e.g., for erosion hazard) in Terrestrial Ecosystem Survey soils data for purposes of Wood Supply Analysis. He has found over time that that TES soil survey is a useful tool for the mid-level scale for which it was designed and there is no other landscape-scale dataset available for the study area. Hart explained that operational factors are also important for protecting soils, such as the condition of soils (e.g., wet) and operator skills and having a good skid trail plan. In addition, Dave Brewer, ERI and former soils scientist on the Kaibab National Forest explained to Hampton that since the 1980s or 90s you had to have a major in soils to qualify (needed a minor in soils) to be a FS Soils Scientist. The working group agreed that the layer should be used in their scenario.

Hampton also explained that ponderosa-pine dominated areas in the study area amounted to 2.4 million acres and included stands of pure ponderosa pine, ponderosa pine and oak (pine-oak), and areas defined in LANDFIRE vegetation layer as riparian which should be classified as ponderosa pine dominated. She summarized that the seven factors considered in the analysis of areas the group had decided were not a source of wood supply in their treatment scenario amounted in 27% of the ponderosa pine dominated areas removed from the analysis area, resulting in 1,750,869 acres remaining.

Hampton and Rundall (Senior Research Specialist, Environmental Sciences, NAU) presented the following table:

Factors (in ponderosa only)	**Acres removed**	**Acres remaining**
Initial ponderosa pine dominated areas	n/a	2,412,833
MSO	181,707	2,231,126
MSO, **SDA**	147,256	2,083,870
MSO, SDA, **slope**	59,155	2,024,715
MSO, SDA, slope, **completed treatments**	64,223	1,960,492
MSO, SDA, slope, completed treatments, **Goshawk nest areas**	52,249	1,908,243
MSO, SDA, slope, completed treatments, Goshawk nest areas, **soil restricted from mechanized treatment**	56,969	1,851,274
MSO, SDA, slope, completed treatments, Goshawk nest areas, soil restricted from mechanized treatment, **streamside management zones**	100,405	1,750,869

To further explain how ForestERA had accounted for the overlap in removals, they presented the following table:

1. Mexican Spotted Owl PACS	181,707
2. Specially Designated Areas	177,477
3. Steep slopes (>40%)	147,067
4. Marked and completed treatments	65,030
5. Goshawk nest areas	63,019
6. Soil restricted from mechanized treatment	126,139
7. Streamside management zones	144,762
Total Acres (including overlap)	905,201
Overlap among all layers	-243,237
Total Acres (excluding overlap)	**661,964**

Rundall then displayed maps of each layer showing how they progressed to the total removal area. This demonstrated the most up-to-data layers and number of acres that would be removed from wood supply. She described information added since last meeting including new data on treatments. Some additional data will be included from A-S once their layers are ready.

Hampton reviewed material covered in previous meetings concerning the fact that streamside management zones are treated differently by each forest. The working group had asked to see a layer showing a 100ft buffer on either side of streams as a possible removal, which ForestERA displayed explaining that ephemeral, intermittent and perennial streams were all included for all

forests except the ASNF because separate classifications for ephemeral and intermittent were only available for that forest. She mentioned that a layer of perennial streams only was available if the group wanted to limit the zones to those stream types. The working group approved the layer with the 100 foot buffer on all streams for use in their scenario.

Rundall displayed a Forest Service road layer with ¼ and ½ mile buffers as requested at the last meeting by the group. A participant requested the proportion of areas outside of the ¼ mile buffer area to use as a potential removal as it may be inaccessible to harvest. Hampton then explained that with the recommendation of the Steering Committee, ForestERA had invited Chris Bielecki, Transportation Engineer, Apache-Sitgreaves National Forest and two industry representatives with years of experience using Forest Service roads for harvesting (Dwayne Walker and Ed Martin). Although Ed Martin did not attend, ____ and Walker were present. Bielecki expressed that it sounded like the group was going to treat all roads the same. He cautioned the group in using just a blanket road treatment. Some roads were built to accommodate steep area harvesting. Environmental documentation needs to account for this. He explained that arterial roads and ¼ mile from them are basically treated as accessible to harvesting. More primitive roads are potentially in need of improvement adding costs or operational strategies. Road access is presently viewed from a public access perspective and some changes may need to be made if access for wood supply is considered. The ¼ mile buffer shows areas that can be accessed with no additional work. Beyond that there are roads that can potentially be utilized but might need improvements. Lower standard roads have about 60% confidence to be inventoried. How many of total roads vary by forest. In terms of feasibility many roads can be improved depending on economics. [Bielecki provided the following written notes at during the meeting:

1) Every square inch of desired treatment is "feasible," but consider that environmental and economic impacts are proportional to decreases in road standard and increased distance from these routes.
2) There is a different level of environmental and economic impact based on standard of road and distance from roads.

- Generally, treatment areas within ¼ mile of operational maintenance level 3-5 roads are immediately available (no improvements required; access aprons may be required for fed/state highways)
- Treatment areas within ¼ mile of operational maintenance level 2 roads are available w/minimal road improvements and/or maintenance
- Treatment areas within ¼ mile of operations maintenance level 1 roads are available w/ moderate road improvements (ranging from removing closures and blading to full reconstruction).
- Treatment areas beyond ¼ mile of exiting roads are available w/adding temporary or new system road mileage (generally requiring a level of physical impact greater than utilizing existing system routes).]

One participant said in a study he had conducted around the San Francisco Peaks Wilderness Area near Flagstaff that the FS roads layer captured 80-90% of the roads according to their assessment. Another participant mentioned that most roads need some improvements for chip trucks like grading them. Another pointed out that in most of the forest that you can not walk very far without hitting a road.

Q: Is there a way to make a judgment as to whether an economic or environmental limitation is present? We really need to find what is likely to be treated, and the roads layer does not appear to be that useful.
Q: Do we want to use the ¼ or ½ mile buffer? The ¼ mile buffer has significant implications for limitations on wood supply.
Participant response – there are some limitations given the use of chip truck and some of the roads that are adequate. We may need to look at past projects to estimate limitations and new technology and operational equipment may eliminate some limitations. Another suggested that we use some of the information from past contracts and constraints, however constraints likely differ between forests.

The point of the discussion was to determine what distance is realistic to identify an access limitation. One participant commented that ¼ mile is not a realistic distance and that ½ mile buffer is more realistic, we should not be considering ¼ mile buffer. Bielecki – we can look at the categories that have been realistically used in the past. Participant – there is going to be a significant change in the type and quality of the equipment used as contracts forest restoration get under way. Participant – would not like to see roads access on historic economic standards since these are changing. Participant – the group in not tasked with assessing the economic ability to access areas or do this assessment.
Q: Is there are number or distance to use from the operations stand point?
Participant – 2/10th of a mile from a landing is used for developing a logging plan and then road condition and time of year when accessible. Most areas have been accessed at some point in the past to access timber. There are very few acres that have been limited for logging by access. Most of the limitations have been due to other factors. Participant – most access has been limited in the field because there is no available road. Participant – part of this discussion is to come to some zone of agreement to allow restoration to occur on a larger scale than in the past. There are many users concerned with the use and improvement in roads. We should take a very conservative approach to create a very durable recommendation to get political agreement. Participant – the main thing is that the roads layer indicates that the roads are there but may not be the exact location. Over time we see the roads as needing to be different depending on the operational use – it depends on the past system installed and what the current operations require.
Q: Can we possibly rule out the building of any new roads especially near Flagstaff? Bielecki – legally new road construction is defined as extending roads a mile beyond the current system. We should not have said no new roads since road construction can be minor and still be legally considered "new road construction." Participant – there are some project level details that should not be considered here. Participant – there are too many roads already on the map. But regardless we are not going to run a chip van down all of the roads that are shown there. I think that a ¼ mile buffer is good, unless more forwarders are used out there. Participant – we are not defining skid trails are new roads, right? So why not use ¼ mile since there are a lot of other ways to remove chips from the forest than the truck.

Participant – We need to consider roads because of the estimate of the amount of biomass taken out of the wood depends on it. We need a quantitative estimate from using the existing roads to understand biomass that is available for restoration. Participant – we are not necessarily talking about an environmental limitation, but an operational one? Participant – there are many individual out there concerned with roads and road densities so we should be careful with our recommendation. Participant – we should be cautious also to not limit future activities with

information from past logging and the spaghetti of roads out there. Participant – some future harvesting also would afford opportunities to close existing roads and get rid of that spaghetti pattern. Participant - to summarize, our opportunity here is to responsibly estimate the amount of wood volume and the number of acres accessible related to wood volume, that is, a conservative estimate of access and access management. Hampton said that ForestERA would generate the number of acres removed if ¼ and ½ mile buffers were used to estimate accessibility.

Define management objectives and select treatments – Fire subcommittee report back
Brett Dickson (Assistant Research Professor, Environmental Sciences, NAU) reported back on Fire small group efforts (up to 30 minutes) since last full group meeting. The purpose of the group is to identify areas where fire could be used as a first management option. The group had concerns over how the fire models were characterizing fire behavior at the 95th percentile weather conditions. Brett worked with Chuck McHugh and Laura Kurth to predict fire behavior at the 97% level and there was little change in the surface fire area extent and conditions. Crown base heights are driving the model predictions and there is a lot of sensitivity in the model for surface to passive and passive to active crown fire. Brett mentioned that we have consulted with the Missoula fire lab to find out what manipulation of inputs may be necessary to get potentially more realistic runs. The recommendations were to make extreme adjustments in crown bulk density and other inputs and would involve making too many assumptions. Dickson presented the following slide summarizing the status of the fire modeling efforts for the Wood Supply Analysis:

- Derived new fire models for 97th percentile weather conditions, however:
    - Surface fire predictions relatively unchanged from 95th
    - Canopy-base height still "too high" in many areas of predicted surface fire = "truth" + "fiction"
    - LANDFIRE inputs require significant adjustment
- USFS Fire Lab cannot recommend a "better" model
    - Large landscape prohibits models of fire dynamics
    - Areas of fire only could be identified using, e.g., current or desired future conditions

Dickson also consulted with Pete Fulé (NAU Associate Professor and ERI employee), regarding how to pin down forest structural conditions that would potentially support or potentially prohibit the transition from surface to a canopy fire.

- Forest structure conditions associated with surface fire behavior (Pete Fulé, ERI)
    - 160 trees/acre (400 +/-100 trees/ha)
    - 109 ft2/acre (25 +/- 10 m2/ha)

Dickson also explained that ForestERA had prepared several spatial layers from their canopy cover layers that could be of use to inform efforts to use fire behavior as an indicator of areas that can potentially support fire as a first management tool.

- Canopy cover thresholds of 10%, 20% and 30%
    - 30% is lower end of canopy cover range in DFCs identified by scenario attribute group.
    - 10 to 30% encompass range reported in manuscripts and unpublished data following restoration treatments and reconstructed pre-settlement conditions.
    - Canopy cover is the highest accuracy layer available for the study area

Q: What is the objective of this discussion? Participant – to identify areas that could be managed right now with fire treatments. Participant – we are developing methods to analyze areas where mechanized treatment may not be appropriate and fire is one available tool that may be used. Participant – is there some kind of value judgment made as to why fire would be used instead of mechanical treatment? Participant –I'm not sure canopy cover is the best structural parameter to use for this. Participant – there are some areas that we are running into critical thresholds with smoke that will play a role in the number of acres that can be burned. Participant – canopy cover is an estimate of the cover of trees, not necessarily a density of trees. Participant – if you can use fire and get the same result as thinning treatments, we should look at those. Participant – if we can use fire and achieve restoration results, we should consider these areas and take that out of the wood supply. Participant – from a restoration point of view, there is no published information that suggests that 160 trees per acre was a historic condition. You might be able to get a surface fire through a 100 tpa stand, but you would not get to a condition that would be considered restoration. Participant – if you still achieve the desired future condition, via fire or mechanical, either method should be considered.

Participant – it is not still clear that we can politically restore fire to these systems, that discussion is not yet mature. Our objective is to come out with a recommendation and agreement that each member can present to their constituencies that is acceptable. I will not be able to find agreement where treatments recommended do not find that middle ground that is reasonably acceptable to all. There is more to this than just this group, but also interested individuals outside the group. Participant – we have almost 30% of the landscape that is already taken out of the supply, does that help provide by-in or agreement? Participant – no, it is not just that 30%. I thought that we would get more and quick acres to take out based on fire behavior models and we did not get that. Participant – we are not here just to look at areas where burning can be applied, but also where mechanized treatments can be applied. We should to swing from one side to the other. We have been looking for a starting point where we might be able to suggest areas where fire might be applied. Participant – it worries me that we are trying to identify prescriptions and where they should occur. I have no problem saying areas should be taking out of wood supply that can be treated with fire, but where there is a resource that can be utilized it will not go over well with others looking at the results of this process. Participant – there are plenty of areas where fire can be used as a treatment right now. This is a compromise perspective. Participant – I have heard Harv Forsgen say that we are trying to get forests back to a restored condition where we can have the use of prescribed or natural fire in the future. There are some criteria that can be used as to where fire can be applied in the future that can be combined with the fire models. Participant – we should use the desired future condition and let the restoration goals suggest what the treatments should be…we should move along and identify those areas where prescribe fire might be used as a first management option. Participant – where we have the opportunity to use fire, we should consider some of the other ecological problems of using mechanized equipment on sites such as exotic or invasive species. We should look at the DFC and move forward with treatments to get us there. Participant – We can put fire into some areas that can right now support fire to get us to the DFC. If you are looking at getting just to the ecological condition, then fire could get to you the restored condition. If economics play a role, then harvesting some of the biomass should be considered. Participant – there are still a lot of area that could be treated with fire if we could do unlimited burning, but smoke management is an issue. We should be capitalizing on the mechanically treated areas to be able to use fire.

Dickson – As we move forward, think about the DFCs and whether these conditions can help suggest sideboards for the type of treatments. Is there additional information that we can give to the sub-groups to help move forward with the scenario?

Steve Sesnie: *Wood volume estimation*
Sesnie reviewed the wood volume analysis methodology described at the last full group meeting. He will be using Forest Inventory Analysis vegetation plot data as it covers the entire analysis area in a 4x4 km grid combined with satellite, elevation and other spatial data layers at the 30m pixel scale. He'll use K-nearest neighbor calculations to impute areas for which we don't have volume data.
Q: Will Stewardship contract data be used in your analysis? Sesnie explained that he will be using stand exam forest inventory data and this will be helpful to assess accuracy. I may use some procedures to track down main sources of errors in the prediction.
Q: Will you have results for the next meeting? Sesnie stated that he will have results to show at the Nov. 16 meeting.
Q: Do you anticipate your projection will show the differences between wood supply estimates between forests as described in the progress report? Sesnie stated that if the plot data indicated differing initial conditions between forests that this may lead to different estimates of supply between forests.

Define management objectives and select treatments – Scenario attribute subcommittee report back
Diane Vosick summarized the revisions that the Scenario Attribute subcommittee made to the forest treatment scenario worksheet since the last full working group meeting on Sept. 17. She reminded the group that they needed to keep in mind that every acre is under the jurisdiction of the goshawk guidelines. However, there is flexibility in the guidelines that would allow differing treatment activities. Participant – we have guidelines of how goshawk treatments are implemented, but that is an over-arcing guide, not information that can define a treatment level in our scenario. Participant – the set of potential treatments included in the scenario are to be used as a straw man and presented to the group to help quantify the amount of wood volume. You need numbers (DFC) to get numbers (wood volume).

Vosick reviewed the treatment areas and DFC of each area while ForestERA displayed maps representing each area discussed (e.g., Community protection zones, MSO restricted habitat, municipal watersheds, wildlands, etc.). There is a wide basal area range of in the wildlands as the group might be sensitive this large area.

Q: Will there be a volume estimate for each end of the range and the middle, for example? Participant – This was proposed by the scenario attribute group, but we need to discuss where different levels of treatment might be applied in terms of distributions, such as in wildlands, to give ForestERA a location and level of treatment to estimate wood supply. Participant – should we expect to have a number of different scenarios with a range of treatments and is that enough of a recommendation to R3? This will be important as to how we proceed from this point forward, for instance having such a range of treatments and different treatments. Participant – it might be good to have a range of treatments to suggest what is acceptable. Participant – it will be tricky to come to agreement on a particular treatment, as a set of several scenarios. Participant – We don't want to just take of the average of the low to high scenario. The ranges represent a set of ranges within

certain areas (landscape features). Participant – we have to have a final product that is useable and the zone of agreement that everyone is happy with. This suggests some tighter sideboards on treatments in a given area than currently on the scenario worksheet. Participant – is there a way to begin thinking about narrowing down the DFC that is realistic. Participant – we should work systematically through the table and come up with DFC ranges that the group agrees with.

A scenario attribute subcommittee member reviewed the general notes on the scenario worksheet: 1) ForestERA will calculate wood volumes in severely burned areas, falling within fire perimeters, across the full study area, so as not to include them in total volume analysis. There is not sufficient agreement related to available supply from severely burned areas, thus these areas were not identified as sources of available supply in this analysis. 2) Archeological sites and other project level factors can reduce acres thinned and intensity of thinning. Total volumes will be corrected using a reduction factor to account for these sites. Volume estimates stemming from this project will be presented in terms of ranges. 3) Areas once dominated by ponderosa-pine that mixed-conifers have expanded into are not considered in this study. 4) No burning should occur following ponderosa pine thinning in riparian areas.

After discussing the last item the group agreed it was too prescriptive and should be changed to "Burn when appropriate following ponderosa pine thinning in riparian areas." The subcommittee member further explained that salvage logging is a difficult area to reach agreement on, so the group recommends putting this aside and not considering it in this process. Participant – we need to develop some number or range of numbers to reduce wood supply, for example for archaeological sites. Participant – are there areas that we would apply different "project level" factor for wood taken out where there are archeological sites? Participant – yes, different forests have different amounts of these sites.

Q: Can you map old growth? Sesnie explained that he conducted a Forest inventory data analysis on the North Kaibab Ranger District mapping old growth and defining different stages of old growth condition. It involved defining conditions leading to and away from old growth conditions due to fire removing trees. He plugged data into FVS and projected out where old growth conditions would occur. Participant – On CocNF they identify old growth as project level planning. VSS6 are considered almost or old growth. Many stands do not have old growth so they designate stands that are approaching old growth.

Q: Why are we deviating from what is the place of importance or area of importance decided by the community. Member of the WUI subcommittee – community protection area layer was developed based on what we thought were important areas for community protection. For example areas up-wind of the prevailing winds. Participant – the community protection layer has the benefit that all private lands will receive some level of treatment, as not all are included in the CWPP priority areas. Participant – the sub-group found that that definitions and process used to define the WUI in CWPP was applied differently across these communities. Participant – from the state wide strategy, we found that communities perceived themselves and boundaries differently across the state. Participant – the consensus achieved from the CWPP WUI is somewhat undermined by redelineating the boundaries. Q: if the group can articulate why the boundaries have been changed that would be presented in the report, would that be enough for the communities that originally identified them. Participant – no, I think that a member or members of the community might be unhappy with undermining their original decision and WUI boundaries. Participant – We should not undermine what the communities have decided. We could

demonstrate both layers showing the high priority zones identified by the community and other zones that could realistically be protected. Dickson– there are some question about inconsistencies methodological approach used and the data used that were identified as having treatments or not (in the CWPPs). The type of treatments are not specific enough to implement them in the context of estimating wood supply.

Participant – I want to honor what the communities have decided as they have worded hard. Participant – there was too much flexibility allowed communities for identifying priority areas so there is less consistency in the prioritization. Participant – why does if matter that communities came up with different types of priorities? Participant – we need to consider that the policy developed for the CWPP areas and decision making was not necessarily consistent with landscape scale restoration treatments. Participant – we have no option but to consider what the communities have defined. Participant – the Forest Service only has to only consider the CWPP under HFRA. It tells the Forest Service whether the CWPP is consistent with intent of the policy. Participant – we can probably move on from this with the idea that we explain the difference in the volume and areas for CWPP. Participant – use two sets of estimates based on a selected scenario from the ForestERA process and then also one with the CWPP less specific estimate. Hampton – we will clarify in the report what changes were made in what the communities identified as priority and what was captured by the sub-group. In areas where we don't have spatially explicit information or enough treatment information we will not use the CWPP.

Sesnie passed out a handout to provide additional information on the post-treatment conditions that would result following the three thinning levels (low, moderate, and heavy) for three forest structure metrics: BA, CC and stem density. Also shows distributions from FIA data of these stand parameters. Note that 300 t/a is average conditions and that ending condition for heavy, moderate and light thinning potential treatments differ depending on initial conditions. Hampton pointed out that the range of community protection DFCs for basal area approximate those of the post-heavy thinning treatment.

Participant – Using a bell curve as the distribution for the basal area ranges is interesting, but we don't have agreement on this. ForestERA should model high, med, and low treatments across landscape so group can see how they play out. I hope we can reach one common scenario that represents agreement to provide to the FS. Participant – Maybe we can define for a certain area a percentage of the area in each part of DFC range. Participant – It's not prudent to narrow the DFC range too much on some areas of landscape. Participant – We are looking at immediate condition following treatment not DFCs. We're managing for DFCs. In SW US we have good info on reconstructed range 15-35 t/ac on fine texture soils, 55-65t/a on coarser textured soils. We'll have to plant trees to make the DFC in the current scenario. Participant – We're calculating the amount of wood following treatment so we should use PTC, post-treatment condition. Participant – But we don't have Powell Plateau conditions, so we're erring on side of more trees, DPTC. Participant – We could say that anywhere within range is OK. Some have too wide of ranges. Participant – If we have high BA and low densities then it will be on one end of DFC range. We should state which initial conditions lead to what part of DFC/DPTC range. Participant – Could take low, med, and high part of DFC ranges and use predicted effects on MSO, squirrel, etc. then this will be an information based process. This is arbitrary unless we consider these factors. Participant – Why is the range for municipal watersheds so wide if MSO is taken out, such as for Lake Mary watershed?

ForestERA reviewed the data layers used for the scenario. Sesnie summarized how MSO restricted habitat layer was derived. Pine-oak was taken from LANDFIRE and ForestERA vegetation layers. He found target/threshold conditions were met on some areas on the Tonto NF using forest stand data. Hampton explained that infrastructure such as interstate highways and roads were buffered and power lines also (50 ft buffer) at the request of the scenario attribute subcommittee. Participant – the right-a-way is wide depending on the size of the power line. Participant – the Forest Service thins heavily, rather than clear cuts under these. Participant – why do we consider these if they are going to be treated already anyway? Participant – not always treated, lump these infrastructures with priority community areas.

Participant – there are more areas that the Forest Service has identified as level six municipal watershed (Eager South area is already marked for treatment in one).

Haydee – We used data on native fish provided by Shaula Hedwall (from Bureau of Reclamation), TNC (native fish on perennial waters), and the University of Kansas to develop a layer of the 6th level watersheds with native fish. A ForestERA layer of high post-fire sedimentation areas were used to narrow the number of native fish habitat 6th code watersheds to form a second layer. The models predict potential sediment load from a large fire and not from treatments.

Participant – we need an estimate of volume from different tree size classes so that we can tell the model which trees to cut. That is a critical part of this analysis to calculate wood supply – which size class of trees are going to be cut and the volume from that.

Hampton – we have calculated topographic position to identify canyon areas to protect. Treatment areas would be along rim areas Participant – many of the canyon areas will be MSO habitat, so this layer does not provide much useful information (many agreed). Participant – in reality the edge of canyons, if just a small strip surrounded by areas that we would not treat, is not feasible for allocating equipment.

Hampton – does everyone agree that these canyon areas should be placed back into the wildlands? Participant – there is some disagreement, I would like to leave it in. Participant – I'm a lumper and this make management planning more complicated, without buying anything. Participant – we should drop this and move on.

Haydee – For meadows, we have TNC grassland data and TES data on mollisols, an indicator of past grassland and savannah conditions. There are more mollisol areas on the west side of the study area that a FS soils scientist verified is a real condition and not an artifact of the way the soil survey was carried out. Participant – have you looked at the TES potential vegetation data for existing meadows? Hampton – we can look at that, we have the TES data. Participant– the TNC historic grasslands characterization was from a study mainly on BLM land and some of the Apache reservation, not as much information about historic grassland on USFS land.

A participant proposed creating a scenario of PTC, use low, med, high proportion (area) of each PTC for each landscape feature. For example, 20% of the wildlands area would fall in the low basal area range for wildlands following treatments, 60% medium, and 20% high. There was some discussion on this method, but no decision to move forward with it.

Public comment period
An observer asked if the group had done anything with the information provided in an email letter from a Prescott ear, nose and throat doctor to the Working Group by ForestERA as his request. The letter contained information about increase in medical cases associated with smoke generated from burning activities. A participant said that this information was more appropriate for the USFS Forest Plan revision process underway and that she had sent it to the appropriate Forest Service staff. Another observer said he had used LANDFIRE FRCC tools as an evaluation tool. How VSS classes can be used to inform outcomes. Gave old-growth example and how much land should be left in that category.

Parking lot items and logistics for next meeting
Elaine Zieroth announced that Harv Forsgren, Regional Forest Supervisor would be leaving his post on Nov. 7th, Gilbert Zepeda will become Deputy Forest Supervisor (acting), and Corbin Newman will be the new R3 supervisor. Elaine is retiring on Dec. 21st.

Participant – Stewardship contracts need to be accounted for with FS NEPA polygon information – acres committed to Stewardship contract.

Hampton reiterated that she and Sesnie were going to present at the White Mountain Apache tribal planning board meeting tomorrow to ask them for reservation-wide wood volume estimates. The group decided to include wildlife corridor areas in any project level factor applied to wood supply estimates as no GIS data existed for this landscape factor. Tabled for future discussion were old-growth, roads, burn-only treatments, goshawk guidelines and factors for accounting for project level considerations in reducing thinning levels or acres, such as archeological and historical sites.

Logistics
Romero asked the group if they wanted to meet on October 29th or possibly at the end of November after they reviewed how their scenario played out spatially and in terms of wood volumes. The group decided that meeting at the end of November would work better for reaching agreement on their scenario and Thursday November 29th in Flagstaff was chosen as the final meeting date. A proposal was made to have a small group go over the scenario worksheet and use today's discussion to revise the table. The scenario attribute subcommittee agreed to meet to provide ForestERA with recommended assumptions that they needed to complete the analysis to report back to the larger group on November 29th. The following working group members volunteered to serve on the scenario attribute subcommittee: Todd Schulke, Scott Higginson, Shaula Hedwall, Pascal Berlioux, Steve Gatewood, and Diane Vosick. The necessity of keeping the group at a low number of participants representative of the larger group in order to move forward efficiently to develop suggestions to present to the larger group was discussed and agreed upon.

Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona

November 16, 2007
9:00 a.m. – 4:15 p.m.
Large Pod Conference room, Applied Research and Development (AR&D) Building
Northern Arizona University, Flagstaff, AZ

9:00 – 9:15 a.m.	Welcome – *Rosemary Romero* (Facilitator, Rosemary Romero Consulting)
9:15 – 9:30 a.m.	Review meeting agenda, timetable and various project updates **–** *Haydee Hampton* (Research Associate, Environmental Sciences, Northern Arizona University)
9:30 – 10:30 a.m.	**Review treatment scenario** Review Working Group's efforts to date on identifying areas appropriate for restoration treatments and the desired post-treatment conditions for those areas. ForestERA will build the Wood Supply scenario on screen using an additive display of maps highlighting various components (e.g., steep slopes, community protection areas). **–** *Jill Rundall* (Senior Research Specialist, Environmental Sciences, NAU) *and Haydee Hampton*
10:30 – 10:45 a.m.	Break
10:45 – 12:00 p.m.	**Review treatment scenario (cont.)** Complete review of treatment scenario including using fire as a restoration tool where practicable by *Steve Gatewood* representing the Fire subcommittee, with spatial data support by *Jill Rundall*
12:00 – 1:00 p.m.	Lunch *** Lunch will be on site. Working group members may order sandwiches before 9am for $5.00 for a 1/2 sandwich and $7.75 for a whole (check or cash only) or bring their own. ***

1:00 – 2:30 p.m.	**Report out on major project results**
	Presentation on estimates of wood volume by size class for Wood Supply Analysis area and methods for estimating supply based on group's desired post-treatment conditions **–** *Steve Sesnie* (Postdoctoral Research Associate, Environmental Sciences, NAU)
	Presentation on results of project level analysis of restoration treatment areas and intensity **–** *Haydee Hampton and Gary Snider* (Forest Economist and Doctoral Candidate, School of Forestry, Northern Arizona University)
	Presentation on existing small-diameter wood harvesters, mills and manufactures **–** *Gary Snider*
2:30 – 2:45 p.m.	Break
2:45 – 3:45 p.m.	**Address miscellaneous issues**
	Discuss how "parking lot" or miscellaneous items that are not fully or otherwise included in the group's treatment scenario will be addressed in the final project report, such as Community Wildfire Protection Plans (CWPPs), White Mountain Apache reservation-wide volume estimates, salvage logging, old growth, and use of previous landscape assessments.
3:45 – 4:00 p.m.	**Wrap-up and logistics for next meeting**
	The final Wood Supply Working Group meeting is scheduled for November 29th in Flagstaff.
4:00 – 4:15 p.m.	Public comment period
4:15 p.m.	Adjourn

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Introductions and Agenda Review

Rosemary Romero, meeting facilitator, introduced herself and welcomed Working Group Members to the second to the last official meeting. Group members introduced themselves.

Working group members present at meeting:

1) Keith Pajkos, Timber Staff for the Arizona State lands Department Forestry Division
2) Bill Greenwood, City Manager for the Town of Eagar
3) Herb Hopper, Community-based forest and wood products advocate, Little Colorado Plateau Resource Conservation & Development
4) Steve Gatewood, Consultant, Wildwood Consulting Inc., representing the Greater Flagstaff Forests Partnership
5) Pascal Berlioux, President and Chief Executive Officer of Arizona Forest Restoration Products, Inc.
6) Lisa McNeilly, Northern Arizona Program Director of The Nature Conservancy
7) Jerry Drury, Timber Staff Officer for Kaibab National Forest
8) Rob Davis, President/Owner of Forest Energy Corporation/Future Forests
9) Todd Shulke, Forest Programs Director for Center of Biological Diversity
10) Diane Vosick, Associate Director of the Ecological Restoration Institute
11) Elaine Zieroth, Forest Supervisor for Apache-Sitgreaves National Forest
12) Shaula Hedwall, representative of the U.S. Fish and Wildlife Service, Ecological Services
13) Molly Pitts, Executive Director of the Northern Arizona Wood Products Association
14) Larry Stephenson, Executive Director of the Eastern Arizona Counties Organization
15) Ethan Aumack, Director of Restoration Programs for Grand Canyon Trust
16) Kim Newbauer, Timber Sales Contracting Officer for Coconino National Forest

Working group members not present at meeting:

1) Sarah Lantz, Urban Wildlife Planner for Arizona Game and Fish Department (Region II Flagstaff Office)
2) Scott Higginson, Executive Vice President of NZ Legacy/Snowflake White Mountain Power, Renergy
3) Robert LaCapa, Forest Manager, DOI BIA Fort Apache Agency Branch of Forestry
4) Mary Steuver, Acting Tribal Forester, Forestry Department, White Mountains Apache Tribe
5) Chuck Peone, Fort Apache Timber Co.

Project Team Present at Meeting:

1) Rosemary Romero, Meeting Facilitator, Romero Consulting
2) Jill Rundall, GIS Specialist, ForestERA

3) Tom Sisk, Professor, Center for Environmental Sciences and Education at Northern Arizona University (NAU)
4) Haydee Hampton, Research Associate, Center for Environmental Sciences and Education at NAU; Project Director, ForestERA Wood Supply Analysis
5) Steve Sesnie, Post-Doctoral Research Associate, Center for Environmental Sciences and Education at NAU; Remote Sensing Specialist, ForestERA
6) Gary Snider, Forest Economist and Doctoral student in the School of Forestry at Northern Arizona University
7) Jada Ach, English Instructor, NAU; scribe

Experts and Observers:
1) Wally Covington, Director, ERI (supplied expert input)
2) Pete Fulé, Faculty, NAU Forestry and ERI (supplied expert input)
3) Taylor McKinnon, Center for Biological Diversity

Haydee Hampton: Overview of Agenda
Hampton presented an overview of the meeting's agenda commented that at this meeting the two major parallel tracks of the project, collaboration and wood volume estimation, will merge. She referred to the first working group meeting which took place in Holbrook, AZ on June 4, 2007, remarking on the progress that the group has thus far made in terms of reviewing and developing a scenario. During this particular meeting, Hampton noted, the focus should be on revising the final scenario, reviewing wood volume estimates, and agreeing on methods for wood supply estimation. The final working group meeting will take place on November 29 in the ARD building on NAU campus in Flagstaff, AZ.

Hampton informed the group of the timeline for finalizing the project report: report will be submitted to working group and Region 3 by Dec. 17, 2007; comments from working group should be submitted to ForestERA by January 18, 2008; and a final report will be ready to distribute by Jan. 31, 2008. Representatives from ForestERA will be presenting analysis results at a meeting hosted by the Association for Fire Ecology in Tucson, AZ Jan. 28-31, 2008.

Hampton then summarized the working group's email discussion two weeks prior regarding the shift in the upper diameter threshold from 12 in. DBH to 16 in. DBH resulting in the following three classes: <5in. DBH, 5-16 in. DBH, and >16 in. DBH. She explained that the main reason given by working group members for requesting this shift was that the classes should be comprehensive enough to encompass as much of the useable material on which there has been a general agreement. She stated that some working group members had commented that a 16 in. threshold is less informative for some types of industry than a 12 in. threshold, and some members requested an 18 in. threshold to match the top end of VSS4, as used in Goshawk Guidelines.

After reviewing the agenda and the shift in diameter class ranges, Hampton provided the members with updated information regarding their restoration treatment scenario. Jill Rundall displayed maps portraying areas with Mexican spotted owl protected activity centers (MSO PACs), Specially Designated Areas such as Wilderness areas, steep slopes, goshawk nesting areas, completed treatments, streamside management zones, soils with limits on mechanized

equipment, and other areas deemed otherwise unavailable as a source of wood supply by the working group in the total 2.4 million acre project area. Once these areas are taken into consideration, the resulting acreage in the analysis area is 1.8 million acres (see details in table below).

Areas Not Considered Sources of Wood Supply

		Acres
1.	Mexican Spotted Owl PACs	182,000
2.	Specially Designated Areas	177,000
3.	Steep slopes (>40%)	147,000
4.	Contracted and completed treatments	113,000
5.	Goshawk nest areas	63,000
6.	Soil restricted from mechanized treatment	126,000
7.	Streamside management zones	52,000
	Total Acres (including overlap)	860,000
	Overlap among all layers	-222,000
	Total Acres (excluding overlap)	638,000
	Ponderosa-pine lands in study area	2,413,000
	Ponderosa-pine lands remaining	1,775,000

Hampton then reviewed information gathered by Gary Snider regarding 8 environmental assessments (EAs) conducted under NEPA in both Coconino National Forest and Apache-Sitgreaves National Forest. She provided draft estimates of the percentage of areas not thinned on the project-level analysis (22% on average for CNF); for ASNF, the average of areas not thinned was 27%. The group had expressed interest in possibly adjusting the number of areas not considered a source of wood supply in their treatment scenario based on the EA assessment as a greater number of factors, such as archeological or historical sites and wildlife movement corridors, are considered at the project level. One participant commented that these project level values validate the amount of area the group has already decided would not significantly contribute to wood supply. Participant: 26% from the landscape level analysis seems on the lower side given that Designated Roadless/Wilderness are not included. Another participant stated that this is an issue the Grand Canyon Trust has been looking at over the last couple of weeks, and agreement on the issue demands a hard look at what's happening realistically across the landscape. We have reviewed 30 EAs – and have found higher percentages of areas have not been thinned. Here are our averages: mean percentage of thinned on ASNF is 51%, on Kaibab the mean is 47%, Coconino is 37%, with a mean of 45% for all projects thinned.

Hampton then stated that the project analyses completed by Snider excluded meadows and to the extent possible focused on ponderosa pine dominated areas to make them comparable with the landscape-scale analysis of the group's treatment scenario and asked if the analyses used by Grand Canyon Trust did the same. In the CocNF, 83% of the areas included by GCT were dominated by PIPO; the remaining areas did include meadows. Another participant noted that the difference of percentages between these two groups might reveal other methodological differences. It might be important, she said, for the two groups to sit down and make sure they

are comparing apples to apples. Hampton agreed and suggested they meet during a break that day and again before the next meeting. One participant recommended that the calculations be based on each project area and not the larger analysis areas. Participant: Urban interface projects are an issue we need to talk about when discussing this percentage as well. We need to consider land classifications, because a lot of the wood supply analysis area is wildlands, not urban interface where thinning has been favored vs. burning; this may be what is reflected in this difference. Group members decided to hold the current conversation until later in the meeting. Hampton then continued with the scenario analysis.

Hampton reviewed the restoration treatment zones included in the final scenario (see table below).

Restoration Treatment Zones

	Acres	Full Area	Source Area
1. Not considered source of wood supply	638,000	26%	
2. Community protection	355,000	15%	20%
3. Mexican spotted owl restricted habitat	237,000	10%	13%
4. Municipal watersheds	60,000	2%	3%
5. Aquatic species watersheds	313,000	13%	18%
6. Wildlands	809,000	34%	46%
PIPO lands in full study area	2,413,000	100%	
PIPO lands available as wood source	1,775,000		100%
Remaining WM Stewardship Contract Areas*	416,000 (in full area)		
Remaining WM Stewardship Contract Areas	343,000 (in source area)		
PIPO lands available for new contracts	1,432,000		
* Areas remaining to be treated within NEPA Planning Areas between 2008 and 2013			
Areas over ¼ mi. from exiting roads	241,000	10%	14%

The remaining areas available for new contracts comes to 1,432,000 acres. However, the group is still contemplating if more areas should be removed based on the EA study, which is still in progress. White Mountain Stewardship contract NEPA analysis areas amount to 416,000 acres across the full 2.4 million acres ponderosa-pine dominated area. A participant commented that once NEPA has been completed for these areas then the exact project areas within these greater analysis areas will be known. There is no upper limit in the contract. 150,000 acres in the contract is the goal. Participant response: An excess of acreage could go to any contract. Those acres should not be taken out of the wood supply analysis since they are not part of any contract right now. After further discussion the group agreed that the 120,000 acres remaining as part of the initial 150,000 Stewardship contract acres should be used in the report as an estimate of what has already been allocated for the White Mountain Stewardship contracts and thus is not available for new contracts.

Hampton then directed the group members to reconsider the issue of roads as it pertains to the scenario, an issue upon which the members focused much of their attention during the last meeting. After areas of overlap with areas not considered a source of wood supply are not considered, 241,000 acres of land in the project area is further from a quarter mile from existing

roads in ponderosa pines areas (10% of full area, 14% of source area). This might be valuable information for the Forest Service to use since areas greater than that distance (quarter of a mile) are difficult to access with today's chip trucks and other equipment. Hampton inquired what the group's feelings were regarding this proposal from the scenario attributes committee. Participant: My question is this: what would be the best way to present these numbers? The base amount we are confident about? Have an adder, perhaps? Participant response: A quarter mile is the basic skid distance. Participant: This is a conservative number. We have to keep in mind that we are dealing with existing equipment, say nothing of the current condition of the roads. It is probably beyond this group's ability to analyze the accessibility. But the number is there, nonetheless, even if we are unable to get all of these roads in the rest of the area up to the standard for such an endeavor. Another participant mentioned that the group should look 10-20 years from now and consider the machinery that may be available to access zones further than a quarter mile from the roads. He stated that more advanced machinery may then be available, allowing greater access to areas past the quarter-mile mark. Commenting on the language to be used in the report, another participant noted that the roads evaluated in the project area are accessible, and that it is just a question of whether to utilize them or not. They should not be left out of the project because of questions of accessibility; they may just be more expensive to use. Romero paused the discussion, asking the group members to consider the language used to discuss this issue of roads in the report. She questioned how such an issue should be phrased to encompass everything the group had discussed up to this point. Hampton further clarified Romero's question, stating that wood harvesting technology may shift over the next 20 years, allowing people to access more than .25 miles. She asked the group how this issue should be portrayed in the scenario. A participant responded to this question by stating that it is unlikely that there will be mechanical treatment in those harder-to-access areas. The narrative of the report, he stated, should characterize the issue in that way. He suggested that we should give the current available/accessible landscape a value – albeit, a conservative value. In addition, the narrative should discuss the road network; the working group does not have the ability to judge what is and is not usable. The narrative should therefore state that with existing technology, it is unlikely that there will be mechanical treatment in these areas. Participant response: Why are these areas still included in the total number, then, but left out? Mechanical treatment may be unlikely today, but should still be considered when discussing future supply. Some participants stated that different scenarios should be described in the report, one of them discussing the issue of future technology. One participant stated that grants are currently being written for such advancements in technology, making this more of an economic issue than a technological one. The group chose to go with a suggestion by one member on the use of confidence intervals in the report, outlining that supply may be derived in the future from additional acres with moderate or low confidence. When more acres become possible in the future, these items of lower confidence may then be realized.

Hampton then outlined the scenario attribute subcommittee's proposed strategy for defining post-treatment forest structural conditions in each landscape zone using recommended basal area ranges (i.e., in community protection areas the subcommittee recommended a range between 30 and 60 ft^2/acre with a mode, or most common value, of 40; in municipal and aquatic species watersheds 40 to 120 with mode of 60; in MSO Target pine-oak habitat 60 to 120 with mode of 100; in MSO other restricted pine-oak habitat 45 to 120 with mode of 70; and in remaining areas or "wildlands" 40 to 160 with a mode of 80 ft^2/acre). The subcommittee also provided ranges of

desired post-treatment conditions for canopy cover and tree density as guidelines. She noted that ForestERA has not determined that it is possible to model treatments across the landscape in this way since the methodology differs from what ForestERA has used in the past and given time limits on the project, but they have been working towards getting as close to this as possible and will at a minimum include a description of the group's desired future conditions in the report even if they need to use a more simplified approach. One working group member was concerned that using a mode of 80 ft^2/ac in the wildlands would leave the forest too dense to reduce the threat of high severity wildfires. Another member stated that the subcommittee chose a range of basal areas in order to increase the post-treatment heterogeneity of the landscape. He also noted that there were no numbers on the y-axis of the chart as ForestERA has not yet derived curves representing 100% of the basal areas in each zone [i.e., probability density functions] from these curves hand drawn by the scenario attribute committee. They will need to determine the y values for each curve in a subsequent step. Subcommittee participant: The tails of the curves could shift a bit. There is nothing prescribing what those numbers should be. We are trying to push towards a heterogeneous landscape. In the narrative we need to explain why we came up with the numbers for the tails that we did. Hampton asked the group if they agreed to include the distributions in their scenario as they were currently presented; Romero tallied the group and established that consensus had been reached on this issue. Members then discussed what would be an appropriate patch size within which each basal area distribution would apply, however did not come to a conclusion. Hampton commented that this would add greater complexity to the modeling which ForestERA may not be able to include in the analysis given time and resource constraints, but understood that this was of interest to the group even though no specific patch size was decided upon. At any rate, this issue of patch size will be included in the narrative.

Steve Gatewood: Fire Subgroup

Gatewood presented information discussed by the fire subgroup since the last full group meeting, stating that the group has focused heavily on where fire-only should be used on the landscape as a restoration treatment. This is relevant to this process as it could impact the quantity of restoration by-products from mechanical treatments (followed by prescribed burning). On the other hand, where is wildfire such a great threat that we need to use mechanical thinning, he asked? Can we define conditions where prescribed burns would be the preferred treatment? Among the factors the group needs to consider when assessing the preferred treatment are weather conditions and structural characteristics. To seek information regarding these questions, the fire group asked, Pete Fulé, Associate Professor of Forestry at NAU and ERI faculty member for his expert opinion. This information was sought to enlighten the working group on issues regarding burn only treatments as they relate to forest restoration and wood supply. In response to a question regarding appropriate treatment strategies under various weather conditions, Fulé responded by saying that under the right conditions, any forest can be burned. In other words, the right weather conditions, when combined with the right fire, will result in a successful treatment. Fulé had been asked whether there was a set of forest structural parameters that one could apply across the landscape to assess where prescribed fire may be the best first-entry tool. Fulé responded that a good rule of thumb would be to consider areas with less than 100sq ft/acre and less than 100 trees per acre, however went on to say that these are complicated questions, and the weather question asked is the only one with a real answer. The forest structure question has more to do with people's interests and opinions. Nothing is set in stone, he then said, and other opinions are valid as well, when discussing these issues.

Gatewood then commented on the percentage of the landscape that falls below 109 ft2/acre BA and 160 trees per acre, which cover between 6 and 10% of the landscape as calculated by ForestERA based on 2006 forest conditions. These are very thick, dense forests. How can we look at those numbers/ranges/percentage sets – where and how much do we want to draw on this analysis? Two parameters affect how the landscape is shown. Hampton then provided maps revealing three different basal area thresholds (below 100 ft2/acre BA, 70BA, and 50BA). Below 50BA (10% of landscape), below 70BA (22% of landscape), below 100BA (40%). Gatewood reiterated that different treatment plans for these three ranges would need to be discussed. Maps revealing trees per acre are not yet available, she said, but will be developed in the next several days. A participant voiced her concern by stating that the fire issue was a NEPA decision, and she was not sure why it should be debated in the context of the working group. NEPA decides what the best tool is and how much smoke we can put into the environment. Proximity to communities is taken into account. This group member said that she does support tagging some acres for group consideration, but while fire might sometimes be suitable for a given area, it may not always be practical. Fulé followed up on the issue of practicality as it relates to prescribed burns. In reference to the checker-boarded zones on the basal area maps displayed, he said that one cannot manage fire in zones this small (say, one or two 90m pixels) – fire managers cannot differentiate between pixels on the land and burn that way, so a using a larger minimum patch size for burn-only treatments would be a better way to model these treatments.

A participant encouraged the group to be soft with language in the narrative in regards to fire treatment issue. For the report to appeal to a broader audience, he proposed a "status quo" approach to the burn-only issue. This approach, according to the participant, would assume that the same proportion of the landscape should be burn-only (~30%) as it has been specified in NEPA documents to burn over the last 10 years. Stay with the current Forest Service burn numbers, he urged. Another participant challenged the assumption that burning was always a restorative treatment. While the Gila NF had been earlier referenced as a good example of a area with many successful burns, the member stated that what he has found in his research is that it doesn't always restore forest structure. Participant response: The issue of using fire as a restorative tool is debated across the political spectrum, and if we want to come to some wood supply numbers, we should go with the interpretation of status quo. Some participants voiced their disagreement with this opinion, stating that current FS policy, as it relates to fire treatment, may not be the best way of arriving at the ultimate goal of forest restoration. Also, just because an area is marked for burn-only in an EA doesn't mean it will be burned. Another member proposed a range of burn-only treatments to include in the report's narrative, using 65% as the high-end percentage. He used the example of fire treatments in the Gila NF as a means of demonstrating to the group that fire is already being used as an effective restorative tool. (Many were concerned with the use of Gila as a model for the rest of the project area, as appropriate treatment depends on individual characteristics of each landscape-unit, proximity to communities, and tree density.) Gatewood stressed the need to agree on structural parameters to include in the report. He stated that the report should be able to inform its readers where, exactly, the fire should go on the landscape and this would allow for a more exact determination of wood supply.

Hampton stated that the reasons lands were designated as burn-only in the NEPA reviewed by Snider were due to steep slopes, road inaccessibility, soils restricted from treatments, and MSO PACs. A participant responded by saying that many of these conditions were noted in previous maps, and those zones (soil, no roads, steep slopes, etc.) were already taken out of the available supply area. We now need to look at risk factors in the remaining areas (smoke, urban interface, etc.), she argued, to make our final decision. A participant added that wildlife movement corridors and old growth were additional reasons "NEPA"ed areas were designated burn only and that the group had already determined that these cannot be accurately portrayed in the landscape analysis. Romero asked the group if there were any alternatives to propose besides the "status quo" proposal. Sisk then reiterated Romero, encouraging those participants who did not agree with the "status quo" proposal to voice an alternative proposal. He stated that the group needed to come to some sort of agreement on one proposal if the process is to move forward. After much debate in regards to appropriate treatment, the outlining of spatial parameters, and the purpose of this project (whether the report should propose directives for the Forest Service or not), the group came up with the following three ways of approaching fire treatment strategies in their scenario:

General info:

- NEPA burn-only areas amount to approximately 28% of all ponderosa-pine dominated areas in the analysis area. These burn only areas occur on:
    - Steep slopes, PACs, areas inaccessible from existing roads, old growth areas and wildlife movement corridors
    - Some of these burn-only areas were in PJ
- The Wood Supply scenario's Areas Not Available for Wood Supply (PACs, steep slopes, soils, SDA, streamside mgmt zone, goshawk nests) cover 26% of the study area.
- Burning may not be the best treatment for steep slopes and PACs

Alternatives:

1.) Recent project-level burning levels: Use percent of areas planned via NEPA for burn-only treatments. Most of these areas are included in Areas Not Available, however some are not (e.g., old growth and wildlife movement corridors). The area (acres) of the remaining features will be assumed as the differential between the landscape assessment Areas Not Available and the NEPA burn-only areas and will be indicated in narrative as high confidence as unavailable for wood supply and estimated in terms of average volume per acre. Need to remove Wilderness and Roadless Areas at front end as these are not included in NEPA planning areas. Develop best guess estimate today.

2.) Low risk of wildfire: Use forest structure parameters (basal area and tree density) to define areas where prescribed burning may be the preferred restoration treatment due to low risk of escaped fire or wildfire spread through tree canopies. Develop map showing areas with the following combinations of basal area and tree density: 1) 100 ft^2/ac and 100 trees/acre, and 2) 80 ft^2/ac and 160 trees/acre.

3.) Wildlands focus: Apply more aggressive burning percentage outside of WUI and possibly municipal watersheds. 65% of area burned to reflect current burning in some wildland settings.

Below is general discussion of the three approaches to fire-only treatments to include in the scenario: One participant said that she was uncomfortable with all of the alternatives. She worries about what characteristics would be left were such aggressive strategies to be instituted. There is not enough data, she said, to assess to what degree fire would be a necessary treatment in the project area. We want to say that those areas could be available for treatment and supply in the future, she said, but we have yet to replace the placement habitats of those species. She went on to say that she is not going to recommend the available areas all be burned without additional analysis, as burning may not be the best treatment for many zones in the project area, such as MSO PACs. The member to propose the third alternative recommended that the narrative deal with one of these plans clearly and robustly in the narrative. Unlike stating a specific recommended percentage for fire treatment, he instead wishes the report to offer a range (for example, 10-65%). Such a range should be mentioned in the actual scenario, not lost in a paragraph of the document. A member responded by saying that she worries about the implications of discussing the issue in such a way. The number currently being debated deals with fire treatment, not restoration. How do you get back, she asked, to the best restoration of the landscape's structure and function? The goal of restoration, she reiterated, should be the focus of this discussion. She went on to say that she does not think that 65% of the landscape can safely receive fire. Another participant agreed with this statement, saying that to burn 65% of the forest would be irresponsible. The Apache-Sitgreaves Forest, she said, is a fairly urban forest, ad there would be no way to burn that high of a percentage. Oftentimes fire is the default treatment due to lack of mechanization. We are trying, however, to restore these acres, she said, and if we go through and thin first, then in the future we can get close to burning 65% of the landscape. Today, however, the number will be much lower – close to 10%. We will not be able, she said, to pull off more than that. After a group member asked Hampton what the consequences would be if they did not arrive at a decision during today's meeting, Hampton said that the information would then not be available to present back to the group in their final meeting on Nov. 29. She stressed that ForestERA would need a set of criteria today if the group wanted them to conduct a spatial analysis before the next meeting. Sisk told the group that their ability to shape where they go is now. One participant suggested that due to the high mortality rate that would result in instituting the third alternative at present, the group should highly consider the first alternative. Another member stressed the empirical strength of the second option. He reiterated the need to rethink the basal area and trees per acre, however. If we look at both, he said, we are at 10% of the study area. The group asked if ForestERA could come back with an analyses of 1, 2 and 3 for the next meeting, although alternative #1 received the most support from the group.

The rest of the discussion regarding the issue focused mainly on the range suggested in alternative #3. While some members agreed conceptually on the third alternative, they felt as though 65% was unsafe and unrealistic. Others feared that if wide-scale fire was introduced in wildlands areas, old growth would be at risk. Some members disagreed with option 3 on the grounds of how such wide-scale burning could affect the available wood supply. Some members in support of alternative 3 claimed that as forest conditions change, and depending on various other factors that may change in the future, 65% may not be as unrealistic as it currently seems. Romero asked the group whether these three alternatives should merely be described in the narrative, or if the group should make a specific preference. Hampton said that ForestERA would be able to do a spatial analysis of 2 and 3 fairly easily, although they would have to make some assumptions on patch sizes and other details that the group did not specify. For alternative #1,

she said that ForestERA and the Grand Canyon Trust could meet to bring their project level analyses together. Sisk said that while figures for all three alternatives could be developed, the working group had always tried to resist the temptation to split into multiple scenarios. Including all three alternatives into the report, he said, will not take the group to their final objective. We can look at all three alternatives and present them at the next meeting – all three will come out with a number of supply – but the group should consider coming to an agreement on one (or a combination) of the plans. Rosemary summarized the group's final decision on this item for the current meeting, re-emphasizing Sisk's words of honing in on a zone of agreement. If one alternative cannot be agreed upon, the two options may be possible. Information on all three alternatives will be analyzed by ForestERA and presented to the group at the next meeting for the final alternative to be decided on.

Wood Volume Estimates (Steve Sesnie)

Sesnie provided the working group with information on how ForestERA had arrived at their current estimates of wood volume. Information entered into the analyses includes Forest Inventory Analysis ground data and Landsat TM 2006 remote sensing imagery and digital elevation models. After outlining the data used to predict forest structural elements and estimated volume, Sesnie explained the accuracy of such imputations. Between the observed and imputed data, Sesnie stated he had achieved an r-value of 76% for total wood volume. Some of the final data is currently being re-run to ensure the accuracy of the derived amounts. Sesnie stated that the accuracy for smaller basal areas is not as high since it is more difficult to measure differences below the canopy. Also, where there are high density levels of saturation, volume is more difficult to predict.

Sesnie stated that the total wood supply volume in cubic feet in the pine type was 4.6 billion in the 2.4 million acre project area. With 1.3 billion cubic feet (CF) of this volume being set aside in the working group scenario, the total available volume reaches 3.3 billion CF (see table below for additional details):

Volume category	Total Cu. Ft. (billion)	Vol.%	Acres (million)	Acres %
Total volume	4.6	100	2.4	100
Tot. vol. removed	1.3	28	0.6	28
Tot. vol. remaining	3.3	72	1.8	72
				% of available
Community protection	0.6	20	0.36	20
MSO restricted habitat	0.5	15	0.24	13
Municipal watersheds	0.1	4	0.06	3
Aquatic species watersheds	0.6	19	0.31	18
Wildlands	1.4	42	0.81	46

Sesnie stated that he will be able to calculate the percentage of volume in each diameter class (5 in., 5-16, 16+) after running the grids before the next meeting. To ensure that these estimates

reach the highest level of accuracy possible, Sesnie plans to compare the totals from these categories to total volume.

Hampton then shifted the discussion to wood supply. Hampton reviewed a proposal developed by the Steering Committee and reviewed with the scenario attribute subcommittee for assuming that restoration by-products will largely come from <5 in. DBH and 5-16 in. DBH classes. The report will highlight areas where it is not possible to meet desired post-treatment conditions by removing wood solely from these classes. However, near communities, removals in the > 16 in. DBH class may be realized if necessary. A participant proposed 10% of each of these lower DBH classes should not be removed. The group agreed with this suggested and the plan developed by the Steering Committee. One member suggested including a growth model into the equation as the supply is stretched over the years. Sesnie then stated that growth averages 30 CF/acre a year.

One participant noted that the maps of the project area do not take into consideration the White Mountain Apache Tribe where much wood volume is available on the ground. In past meetings, he said, we mentioned the desire to work with the tribe, and now that we are close to the end of our study we need to act on it. Hampton mentioned that she and Sesnie had traveled to White River on the White Mountain Apache lands on Oct. 18 and met with the Paul DeClay, the Tribal Forester on this issue. A participant announced that sadly, he had passed away several weeks ago and that it would be unlikely for the tribe to provide reservation-wide volume estimates of small-diameter wood for this project. Hampton said she had been in contact with the acting tribal forester, Mary Steuver, who had attended two of the working group meetings, and at the appropriate time, would revisit this issue with her.

In addition to the narrative, Hampton presented a map created by Rundall, that identified treatments recommended in previous CWPPs. Rundall described the types of treatments and intensity of treatments for the areas of Flagstaff, Rim Country, and Apache-Sitgreaves National Forest which are the only CWPPs where specific information on treatments was available. Hampton explained that the idea is to create what we have spatially for CWPPs, not calculated as volume, but just as one scenario. A member questioned how this information would be used, as she was worried that the report may speak against such community-derived treatment plans. Participant response: In the report we plan on discussing why our recommended treatments may or may not match community-approved treatments. We plan on addressing that difference in the report. The member responded by saying the WUIs in her area (Apache-Sitgreaves) were defined by the community, and that the report should not arbitrarily second guess what the community wants. She went on to say that the report has to show why the group is deviating from the CWPP; we may be able to deviate when we prove with science that we need to deviate. Hampton then asked the group if they were ready to decide between the two scenarios for the report: stick with the Wood Supply Analysis community protection zones currently in their scenario, or offer the alternative treatment zones defined by CWPPs. A member stressed that whatever the group decided to do, they must make sure to be consistent in the entire project area. He suggested running it the same everywhere (using the Wood Supply Analysis community protection zones), and then run the CWPP. In other words, he preferred taking a standardized approach, following that standard approach by deviating according to each community's specific wants and needs as outlined in the CWPPs. The group decided to run a consistent application of

treatment zones before consideration of the CWPP. Results would be calculated on a location-by-location basis. In the report he stressed that much care should be taken in deciding how to present this information.

A group member requested that the report should, in some way, address climate issues over the next 20 years in the context of forest restoration and available supply. In the same vein, estimated fire risk, disease, and insect threat should also be placed into consideration. In sum, one member stated that these issues could be handled in a section addressing/estimating future tree mortality. She explained that such an issue should not be handled as a spatial analysis issue, but as a discussion which arrives at a percentage lost in volume. Sisk said that while ForestERA would be able to look at the current trends and project those trends out, such projections always result in there being no forests left. We are left with only uncertainties, he stated, and must therefore rely on adaptive management. The narrative can address these uncertainties, but, it is not possible to provide firm figures on how these risks may affect wood supply or overall forest health. In terms of the final report, several group members have volunteered to supply text for certain sections of the report by Tuesday Nov. 27: Steve Gatewood on CWPPs, Shaula Hedwall on wildlife/restoration treatment issues, Ethan Aumack on burn only treatments, and Lisa McNeilly on impacts of climate change and natural disturbances on future wood supply. Vosick sculpted the narrative for the issue of old growth management and submitted copies to the entire working group during the meeting. Hampton encouraged the group to read through this portion of the narrative carefully and email Vosick comments by Tuesday Nov. 27. These sections will be discussed and finalized at the Nov. 29 meeting.

Gary Snider provided the group with additional information on the 4 EAs from Coconino NF and 4 EAs from Apache-Sitgreaves NF discussed earlier. Taking into account ownership and landscape features, Snider said that, across the board, ~75-80% of these project sites had been set aside for thinning treatments and ~20% had burn-only treatments. The implications of these projects is not yet easy to determine, Snider noted, but he will provide the group with that information once it becomes available. Snider also presented the following updated table for the White Mountain Area (Apache Sitgreaves NF) on Harvesting Contractors for year 2006:

Harvesting Contractors	**Green Tons (old)**	**Green Tons (new)**	**CCF (new)**	**% of Total CCF**
	(thousand)	(thousand)	(thousand)	
Walker Brothers	110.8	129.3	36.9	63.8
Tri Star Logging	44.6	52.0	14.6	25.3
Nutrioso Logging	12.3	14.4	4.1	7.1
Renegy	6.5	7.6	2.2	3.8
Total	174.2	203.3	57.8	100.0

The numbers obtained by Snider indicate that green tons have become heavier – 3-3.5 tons. This shift does not affect CCF, however.

The final wood supply working group meeting will be held on Thursday, November 29, 2007, from 9am-4:15pm at the same location as this meeting (Large Pod Conference room, Applied Research and Development Building, Northern Arizona University, Flagstaff).

Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona

November 29, 2007
9:00 a.m. – 4:15 p.m.
Large Pod Conference room, Applied Research and Development (AR&D) Building
Northern Arizona University, Flagstaff, AZ

9:00 – 9:15 a.m.	Review meeting agenda and various project updates **–** *Haydee Hampton* (Research Associate, Environmental Sciences, Northern Arizona University)
9:15 – 10:30 a.m.	**Review final treatment scenario** Review Working Group's final treatment scenario including areas selected as appropriate for restoration treatments and the desired post-treatment conditions for community protection and other landscape zones defined within these areas. **–** *Haydee Hampton* Present final results of NEPA project-level analyses completed by Gary Snider (Forest Economist and Doctoral Candidate, School of Forestry, Northern Arizona University) and Andrew Frost (Assistant, Grand Canyon Trust) **–** *Ethan Aumack* (Director of Restoration Programs, Grand Canyon Trust) and *Haydee Hampton*
10:30 – 10:45 a.m.	Break
10:45 – 12:00 p.m.	**Review final treatment scenario (cont.)** Continue any remaining review from earlier session. Present alternatives identified at Nov. 16 meeting for addressing fire as a restoration tool – *Brett Dickson* (Assistant Research Professor, Environmental Sciences, NAU) *and Haydee Hampton*
12:00 – 1:00 p.m.	Lunch *** Lunch will be on your own. Working group members are encouraged to bring their own lunch. ***

1:00 – 2:30 p.m.	**Report out on major project results** Presentation on estimates of wood volume by size class across analysis area and estimates of potential wood supply stemming from working group's desired post-treatment conditions **–** *Steve Sesnie* (Postdoctoral Research Associate, Environmental Sciences, NAU) *and Haydee Hampton*
2:30 – 2:45 p.m.	Break
2:45 – 3:15 p.m.	**Discuss project report and potential follow-on economic analyses**
3:15 – 3:45 p.m.	Wrap-up – *Tom Sisk* (Professor, Environmental Sciences, NAU)
3:45 – 4:15 p.m.	Public comment period
4:15 p.m.	Adjourn

Wood Supply Working Group Meeting
Analysis of Small-Diameter Wood Supply in Northern Arizona

November 29, 2007
9:00 a.m. – 4:15 p.m.
Large Pod Conference room, Applied Research and Development (AR&D) Building
Northern Arizona University, Flagstaff, AZ

Introductions and Agenda Review

Haydee Hampton welcomed Working Group Members and reminded them that this was the final of seven working group meetings and the purpose was mainly to review the treatment scenario they had developed over the last half year including estimates of wood supply based on their scenario. She introduced Dexter Albert, a meeting facilitator filling in for Rosemary Romero who could not attend. Dexter asked members to introduce themselves.

Working group members present at meeting:

1) Keith Pajkos, Timber Staff for the Arizona State lands Department Forestry Division
2) Bill Greenwood, City Manager for the Town of Eagar
3) Herb Hopper, Community-based forest and wood products advocate, Little Colorado Plateau Resource Conservation & Development
4) Steve Gatewood, Consultant, Wildwood Consulting Inc., representing the Greater Flagstaff Forests Partnership
5) Pascal Berlioux, President and Chief Executive Officer of Arizona Forest Restoration Products, Inc.
6) Lisa McNeilly, Northern Arizona Program Director of The Nature Conservancy
7) Jerry Drury, Timber Staff Officer for Kaibab National Forest
8) Rob Davis, President/Owner of Forest Energy Corporation/Future Forests
9) Todd Shulke, Forest Programs Director for Center of Biological Diversity
10) Diane Vosick, Associate Director of the Ecological Restoration Institute
11) Bob Taylor, Supervisory Natural Resource Specialist, Apache-Sitgreaves National Forest (Alternate for Elaine Zieroth, Forest Supervisor, ASNF)
12) Shaula Hedwall, representative of the U.S. Fish and Wildlife Service, Ecological Services
13) Larry Stephenson, Executive Director of the Eastern Arizona Counties Organization
14) Ethan Aumack, Director of Restoration Programs for Grand Canyon Trust
15) Kim Newbauer, Timber Sales Contracting Officer for Coconino National Forest
16) Sarah Lantz, Urban Wildlife Planner for Arizona Game and Fish Department (Region II Flagstaff Office)
17) Scott Higginson, Executive Vice President, Renergy Holdings Inc.

Working group members not present at meeting:

1) Robert LaCapa, Forest Manager, DOI BIA Fort Apache Agency Branch of Forestry
2) Mary Steuver, Acting Tribal Forester, Forestry Department, White Mountains Apache Tribe
3) Chuck Peone, Fort Apache Timber Co.
4) Molly Pitts, Executive Director of the Northern Arizona Wood Products Association

Project support team present at meeting:
1) Haydee Hampton, Research Associate, Center for Environmental Sciences and Education at NAU; Wood Supply Analysis Project Director and Spatial Analyst, ForestERA
2) Steve Sesnie, Post-Doctoral Research Associate, Center for Environmental Sciences and Education at NAU; Remote Sensing Specialist, ForestERA
3) Brett Dickson, Assistant Research Professor, Center for Environmental Sciences and Education at NAU; Wildlife Ecologist, ForestERA
4) Tom Sisk, Professor, Center for Environmental Sciences and Education at Northern Arizona University (NAU)
5) Gary Snider, Forest Economist and Doctoral student in the School of Forestry at Northern Arizona University
6) Dexter Albert, Meeting Facilitator, Intrinsic

Observers:
1) Bob Baltes, Baltes Distributed Generation and Camp Navajo Tribal Development
2) Diane Williamson, Earth Friendly Fuels
3) Sue Sitko, The Nature Conservancy
4) Ed Smith, The Nature Conservancy
5) Stacey Hamburg, Sierra Club

Overview of Agenda and Group Treatment Scenario
Haydee Hampton presented an overview of the meeting's agenda including that ForestERA would review the working group treatment scenario and that the group had several final decisions related to the scenario to make that day: 1) how to use the results of the Environmental Assessment review, 2) choosing among the three fire-only alternatives the group developed at the Nov. 16 meeting, and, 3) reaching agreement on several details of how wood supply would be determined, including the post-treatment basal area distributions.

Haydee then summarized the overall goals of the project and the "roadmap" for developing treatment scenario(s) that the working group had developed at their second meeting in Pinetop:

1. Identify areas appropriate for restoration treatments that recover wood byproducts ("what's on the map")
2. Define management objectives ("target conditions") to guide selection of treatments
3. Select appropriate treatments.
    - Calculate supply produced by applying the appropriate treatments across the map
    - Once forest growth recommendations are available, discuss as group if and how to best use them in this study.

Haydee displayed a map portraying areas with Mexican spotted owl protected activity centers (MSO PACs), Specially Designated Areas such as Wilderness areas, steep slopes, northern goshawk nesting areas, completed treatments, streamside management zones, soils with limits on mechanized equipment, and other areas deemed otherwise unavailable as a source of wood supply by the working group within the total 2.4 million acre project area. Once these areas are taken into consideration, the resulting acreage in the analysis area is 1.8 million acres. Haydee noted that tree mortality due to fire, insect outbreaks and other natural disturbances are accounted for in reduced volume estimates. She then reviewed the restoration treatment zones

included in the working group's scenario explaining that at the Nov. 16 meeting the group had decided to include an ASNF estimate of 120,000 acres remaining to be treated as part of the White Mountains Stewardship Contracts even though there is no upper limit to number of acres in the White Mountains Stewardship Contract (at least 150,000 acres is the goal). As there is no spatial information available yet on the location of the project areas within the broader NEPA analysis areas, the contracted acres will be discussed in narrative, but a spatially-derived wood supply estimate will not be possible.

Haydee then outlined the group's strategy for defining post-treatment forest structural conditions in each landscape zone using recommended basal area distributions (i.e., in community protection areas the subcommittee recommended a range between 30 and 60 ft^2/acre with a mode, or most common value, of 40; in municipal and aquatic species watersheds 40 to 120 with mode of 60; in MSO Target pine-oak habitat 60 to 120 with mode of 100; in MSO other restricted pine-oak habitat 45 to 120 with mode of 70; and in remaining areas or "wildlands" 40 to 160 with a mode of 80 ft^2/acre). A participant recommended removing the MSO Target threshold distribution as basal areas are not supposed to be reduced below 150 f t^2/ac in areas where MSO Target Threshold conditions are met. In addition, the locations of these areas are unknown and MSO Target conditions cover only a very small percentage of the landscape. The MSO restricted post-treatment basal area distribution tail should be moved to the right and the MSO Target areas should be assumed to be part of that distribution. The group decided that the US Fish & Wildlife working group member should develop a new MSO restricted curve to provide to ForestERA following the meeting. A member commented that ERI-provided ranges for pre-treatment conditions [in 0.1 to 0.25 acre plots] range widely, from 0 to 337 f t^2/ac.

Review of Past Thinning Projects

Haydee and Ethan Aumack, Grand Canyon Trust, then reviewed an environmental assessment (EA) analysis of the National Forests in the analysis area gathered by Gary Snider, a PhD student at the NAU School of Forestry contracted by ForestERA for the Wood Supply Analysis, and Andrew Frost an assistant at the Grand Canyon Trust. The group had expressed interest in possibly adjusting the number of areas not considered a source of wood supply in their treatment scenario based on the EA assessment as a greater number of factors, such as archeological or historical sites, old growth areas, and wildlife movement corridors, are considered at the project level than possible at the landscape-scale. Gary reviewed 6 WUI projects and 2 Wildlands projects and these had an average area not thinned of 22% and burn-only treatments of 20%. Gary also interviewed Forest Service staff who guesstimated a range of 40-50% of the area not treated on the ASNF and found an average of 38% not thinned on the Kaibab NF. Andrew found in a review of 25 EAs (including 6 of the same reviewed by Gary) an average area not thinned of 37% and burn-only treatments of 34% (and higher values by approximately 4% if a larger area was considered as the area of possible treatment). One participant commented that about 7 of these were in wildlands (vs. WUI areas). NAU and GCT compared methods before the meeting and determined they were using the same if the smaller total area was used. An average of all 27 EAs reviewed by both groups resulted in 36% not-thinned and 33% burn-only. There was a large range in the values: from 0 to 97% of areas not thinned. Ethan responded to various questions on specific numbers GCT presented for various projects saying that are various types of inaccuracies and imprecisions in the data, but that overall the numbers were valid and that the status quo percent of areas not thinned are in high 30s. One participant noted un-thinned areas include MSO PACs, steep slopes, so there is some overlap with areas already considered not a

source of wood supply in the group's treatment scenario. Another commented that this validates what we already removed from a wood supply source, but we may need another fudge factor, such as an additional 12% (the difference between 26% and 38%), to account for the greater amount of areas not being thinned in project completed over the last decade. Several members thought this would not be scientifically credible and that past performance does not necessarily represent future desired conditions. Does the group want to extrapolate status quo conditions into the future? What do the Forest Service reps think: will high 30s be the percent of land not-thinned in the future? One FS rep responded that we should stick with the 26% to maintain the spatial perspective we have been working with so far as new projects will occur in areas with differing slopes and other conditions that may be better represented at the landscape scale that on the basis of 27 past projects. On ASNF we will be not be burning more that 10% of the landscape both as burn-only and after thinning, however we may let fires burn that we have not set, such as was done on the Chiti Fire. On Kaibab, we have found that areas not treated are 37%. Participant: we could use these values (e.g., 37%) as error bars. Participant: current conditions represent mainly WUI treatment, so higher than 38% should be used such as done on Gila NF. In about 4 or 5 large landscape scale non-WUI projects 58-78% of areas on Gila NF, 40-75% were burned-only, with some areas are not getting any treatment. I would like to see more fire oriented projects, so do not like the status quo. Tom Sisk commented that we've looked at the systematic reasons (slopes, soils, etc.) for areas not-thinned. There is no technical way to anticipate acres not treated due to idiosyncratic and project specific reasons; so we will always underestimate the areas not-thinned with a landscape scale systematic analysis. There is an undeterminable number that won't be treated that should be included in the report. We should discuss in narrative this additional range of nonsystematic factors. Participant: Holding the 26% up as the scientific standard is an over-statement, it's just what we could do with the time and tools available. Participant: I would argue for more thinning on the Mogollon Plateau than in the Gila NF. Participant: Getting into the project level percentages in dangerous because the ranges in the values are so great and prefer going with the landscape scale. Let's quantify what the consensus is on how many acres to treat and then say there may be some more for this and that reason.

Participant: There is not consensus on the lower "status quo" limit (38% not thinned). The broader environmental community position as you extend out from community protection zones to the larger wildlands on how much should be treated is likely about 40% of all ponderosa pine to be thinned (60% not thinned). This value will differ among the zones in our scenario, such as higher in community protections zones and lower in aquatic. We've done a good job of determining where the pine would most likely come from and within that area, there would be a certain proportion, perhaps 40% on average, that we could obtain agreement that could be thinned. This position existed before this process began. This is a process to clarify positions, not to change them. Participant: We should tease out the extent of the range of acres according to various levels of accuracy, uncertainty and consensus. Participant: If the environmental community's offer on the table is 40%, let's start there and see if we have consensus on at least this amount. Participant: We should assign confidence levels. We have total confidence [agreement] on this value and less on higher values. Participant: Most of the lack of agreement is in wildlands and this makes up only 800,000 acres which is less than ½ the supply area. Participant: The 40% seems arbitrary, but given that the environmental community supports this as a maximum level of thinning, it is the zone of agreement we should present to the Forest Service, however the majority of the rest of the group prefers about 60% be available for

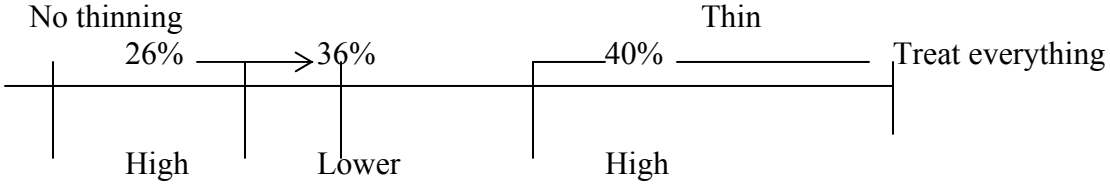
thinning and has a higher level of agreement. The 40% are the highest priority areas to thin mechanically. Participant: I'll throw out these values for consideration: 60% available for thinning in ponderosa pine in communities; 30% in wildlands; 35% aquatic species habitats; 40% municipal watershed, 30% MSO predicted habitat. Participant: Where do these values come from? Answer: The 26% of the area where wood supply is not available that we've come up with here has value. Tom Sisk: It's unreasonable to have expected that the group would all agree. In any problem with a lot of uncertainty, you partition out the where the uncertainty comes from. We have accounted for with great accuracy and high precision, the areas all agree are not a source of wood supply [26%] and have quantified the areas with high uncertainty that we cannot quantify or level of disagreement [between 26% and 60%] due to social and ecological component of the problem that is unknowable. The group has gone as far as it could reasonably be expected to go. Participant: Does the environmental communities' position for an overall 60% of area not thinned (40% to be thinned) include the 26% we already agreed to as a group would not be thinned and if we take out another 6% with no road access, then we're taking out another 28% of the landscape that will not be mechanically thinned? So we do have consensus on the 40% that can be thinned. Answer: yes. Participant: I thought our objective was to reduce the threat of catastrophic wildfire and more acres may need to be thinned in wildlands than 30% to do this. Shouldn't we follow the science? Participant: We're not going through a planning process of what can and should be done. Reality is that 10 years ago many wanted thinning to occur only hundreds of feet from communities. There has been a coming together over time on these issues.

Burn-Only Treatments

Haydee and Brett Dickson then presented the three burn-only alternatives that participants requested ForestERA analyze at the Nov. 16, 2007, working group meeting (see p.8 of the Nov. 16 meeting summary for a description of each), so they could choose one. Alternative 1, Recent project-level burning levels: Brett displayed a map showing where burn-only treatments would be if the lowest basal area regions were selected to total 34% of the landscape outside of community protection and municipal watersheds. Participant: The primary value for mapping this alternative is to provide a process for calculating the reduction in wood supply that would occur if 34% of the landscape had burn-only treatments. Participant: The conversation on the environmental community limit of 40% we had earlier supersedes this discussion. Alt#2 Low risk of wildfire: Brett displayed maps showing areas with less than 100 ft^2/ac and 100 trees/acre, and areas with 80 ft^2/ac and 160 trees/acre; both in terms of 100 acre patches. Alt#3: Wildlands focus with 65% of area with burn-only treatments starting with the lowest basal area regions for all zones except for community protection zones. The basal area threshold ends up being 125 ft^2/ac. Participant: Let's not try to make a decision on burn-only treatments and return to the morning discussion. Participant: Let's try to characterize the zone of agreement on this. The group decided to set aside this discussion aside as it's a subset of the earlier discussion.

Level of Agreement on Percent of Landscape to be Thinned

Steve Gatewood agreed to present the following scale developed by several working group members for describing the group's level agreement on the percentage of the landscape to be thinned and not-thinned:



Landscape
2.4 million acres

Volume
4.6 billion cubic feet

Participant: Where is the science behind 40%? Participant: Some of Mark Finney's work at the Missoula Fire lab informs the treatment of some fraction of the landscape. Tom Sisk: Science has informed the discussions so far, such as the volume estimates and landscape analyses. There is no linear set of logical steps that has lead to the 40%. Society does not run on science. Science can inform society so the deliberative process can reach a social outcome that is acceptable for the greatest number. What's important is what the agreement is, given that we have a wide range of core values around the table. Participant: There are constituents who would like to see their homes protected with greater that 40% of the lands treated. I thought consensus was that two numbers are put out and we work towards the middle. Participant: The 40% is an overall landscape average; the environmental community also would like a higher percentage of area treated near communities, perhaps 70% or more. For the majority of the working group members the 40% is a floor, whereas for the environmental community it is the ceiling. The group discussed two options for determining wood supply: 1) assume the area thinned per zone starts at the highest of the basal areas and go down till the percent for each zone (40% on average) of the landscape is reached, 2) multiply the percent of thinning per zone by the overall wood supply in cu. ft volume for each zone. Participant: There are alternate ideas on how much of the landscape you need to treat. The majority view, not just the minority needs to be expressed. Participant: The variability in post-treatment basal areas is what we should focus on in terms of getting agreement for what the majority has expressed for the 74% area not thinned. So for the high values compared to the low of 40% avg, just use what is left in each zone after 26% is removed. The high value should represent the status quo (~65% of the area not thinned), so adjust per zone percentages to get 65% overall.

The group developed the following language for use in the final report describing their level of agreement: "The group reached consensus that 40% of the landscape should be considered a source of wood supply. There is high level, but not total, agreement that an additional 23% to 34% of the landscape might also be available as a source of wood supply. The group reached consensus that 26% should not be considered a source of wood supply."

Proportion of landscape to be treated in each zone:

	Complete agreement	High level of agreement
Community	70%	63-74%
MSO restricted habitat	30%	63-74%
Municipal Watersheds	40%	63-74%
Aquatic species Watersheds	35%	63-74%
Wildlands	35%	63-74%
Average	41%	63-74%

Wood Volume Estimation

Steve Sesnie presented additional wood volume estimates with a discussion of accuracy for year 2006 forest conditions by three diameter size classes as well as the methodology ForestERA is using to calculate wood supply following treatments specified in the working group's scenario.

Volume category	**Total (billion ft^3)**	**Vol.%**	**Acres (million)**	**Acres%**
Total volume	**4.56**	100	2.4	100
Vol. not considered supply	1.3	28	0.6	26
Vol. considered for supply	3.3	72	1.8	74
Landscape feature		% of total vol.		% of total ac
Community infrastructure	0.64	14	0.35	15
MSO restricted habitat	0.50	11	0.24	10
Municipal watersheds	0.13	3	0.06	3
Aquatic species watersheds	0.67	15	0.31	13
Wildlands	1.31	30	0.79	33
Diameter categories				
Cf <5"	0.12	3		
Cf 5 to 16"	2.45	54		
Cf > 16"	1.96	43		
Sum	**4.53**			

Steve reminded the group that the volume was a whole stem estimate, which includes tops, as was discussed several meetings prior. It does not include branches and needles, but we understand that these residual materials are of interest to some industries. Steve is exploring ways we could estimate whole tree volumes within the time limits of this project to include in the final report. He then turned back to the methodology for estimating supply explaining that he had developed a regression equation between volume and basal area to relate the post-treatment basal areas to post-treatment volume. ForestERA estimated how much basal area was removed in the under 16 inch diameter categories and mapped these spatially. Based on working group comments and advisement from John Bailey (Associate Professor, Oregon State Univ.) we retained 10% of the BA in <5 in. diameter class and 20% of the BA in 5-16 in. class. Haydee

presented maps depicting before and after basal areas in community and wildlands areas. She clarified that the post-treatment basal area layer had been developed by applying the frequency distributions developed by the working group to the pre-treatment basal area in order of low to high BA values. She also displayed maps showing the surplus of basal area that could not be removed solely in the classes below 16 inch DBH. In other words, to achieve the post-treatment desired BA in some areas, it would require taking trees in the > 16 in. diameter class. These areas are few except for the community protection zones where the post-treatment basal area range is lower. Steve explained that in 54% of the area in community protection zones it was not possible to meet the post-treatment BA conditions in the < 16 in classes. The group asked ForestERA to indicate this in the report for each of the zones. The group asked that the post-treatment basal area mode for wildlands be decreased to 70 ft^2/ac and that a sharper decline in values be made.

Wood Supply Final Report

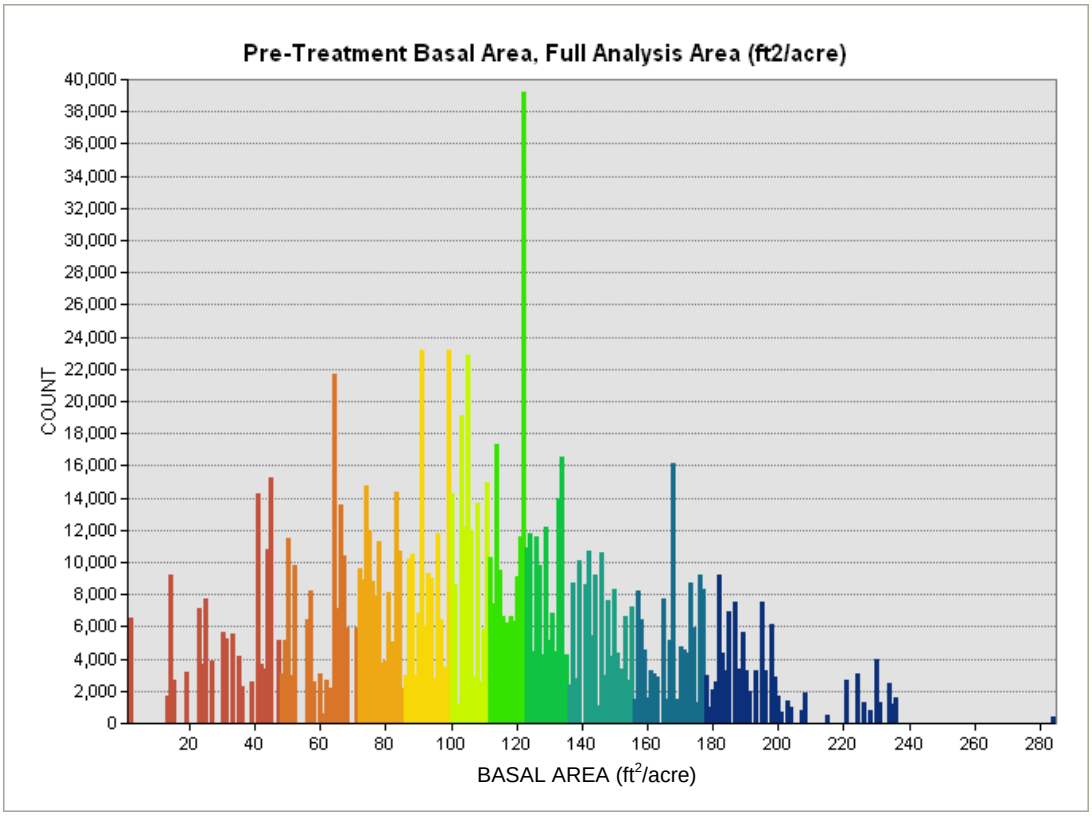
Haydee reminded the group of the timeline for finalizing the project report: ForestERA distributed the report to the working group and Region 3 by Dec. 17, 2007; comments must be provided to ForestERA by January 18, 2008; and a final report will be ready to distribute by late January. The report will include the following major sections:

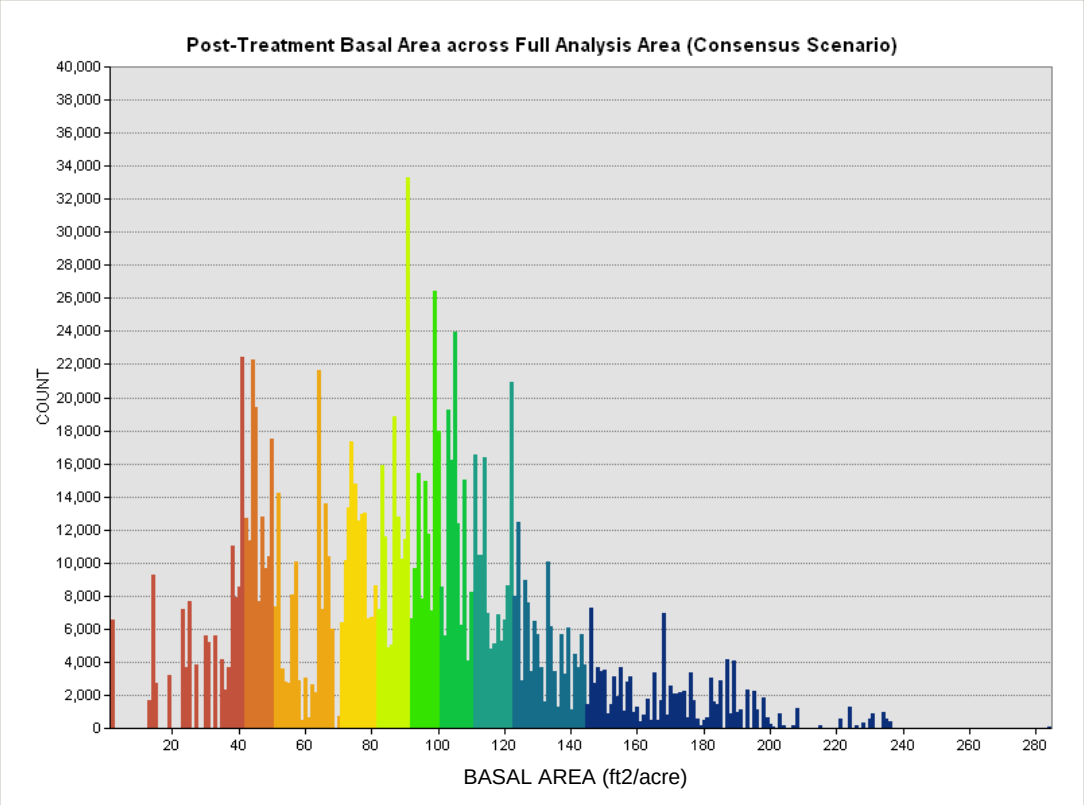
- Background
- Wood Volume Methods and Results
  - Forest growth review and recommendations
- Description of Treatment Scenario
- Wood Supply Methods and Results
  - Project level considerations
  - Existing Harvesters, Mills, Manufacturers
- Other considerations
  - Old growth
  - Climate change and future disturbances
  - Effects of treatments on wildlife
  - CWPPs
  - Burn-only treatments

Haydee reminded the group that she will be presenting wood supply analysis results at a meeting hosted by the Association for Fire Ecology in Tucson, AZ Jan. 28-31, 2008.

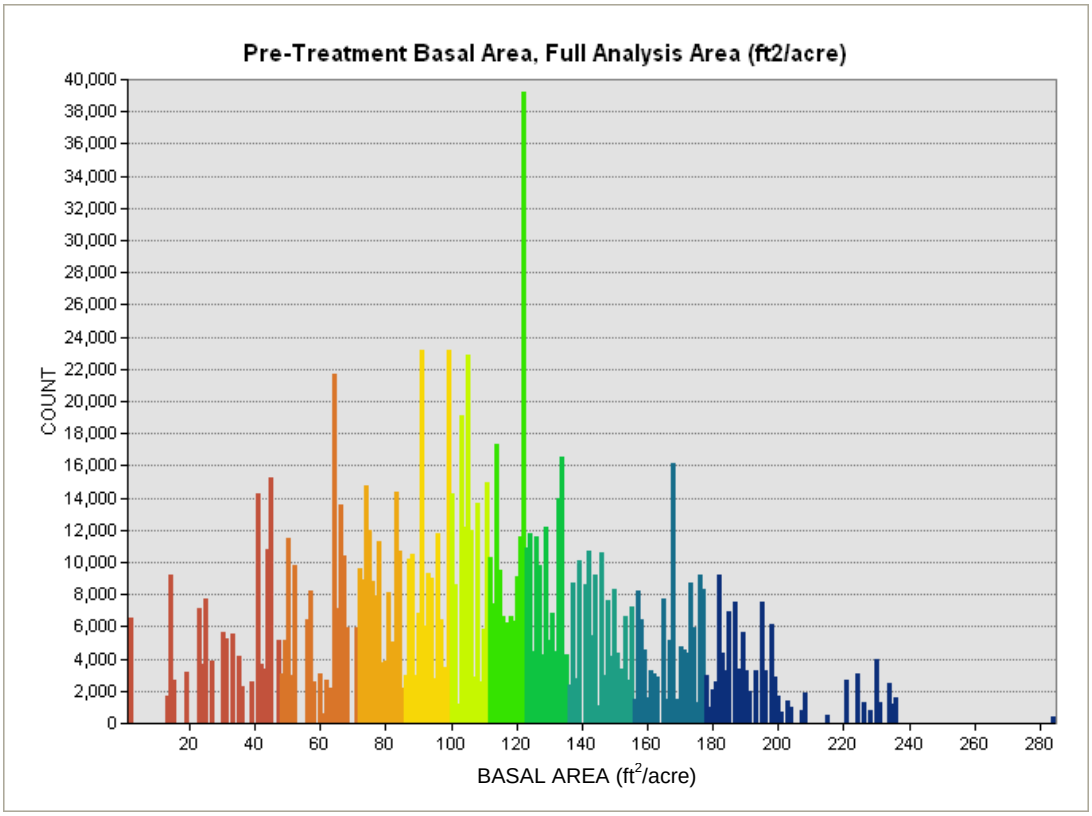
Tom and Haydee thanked the group for their participation over the last half year including recognition of the efforts of the Steering Committee, Region 3 Forest Service, Rosemary Romero, participating experts, scribes, and those who arranged for facilities at the Pinetop AZGFD, Northland Pioneer College, and NAU.

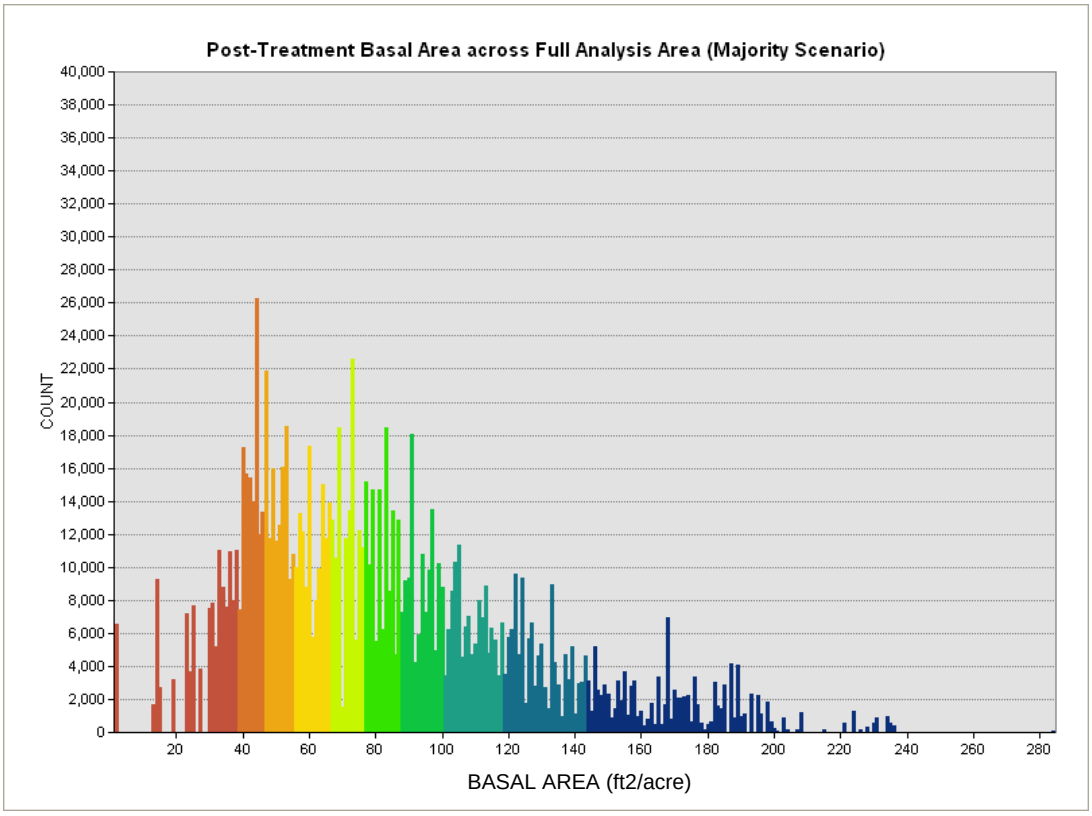
Appendix C. Estimated Pre-Treatment and Desired Post-Treatment Basal Area Frequency Distributions

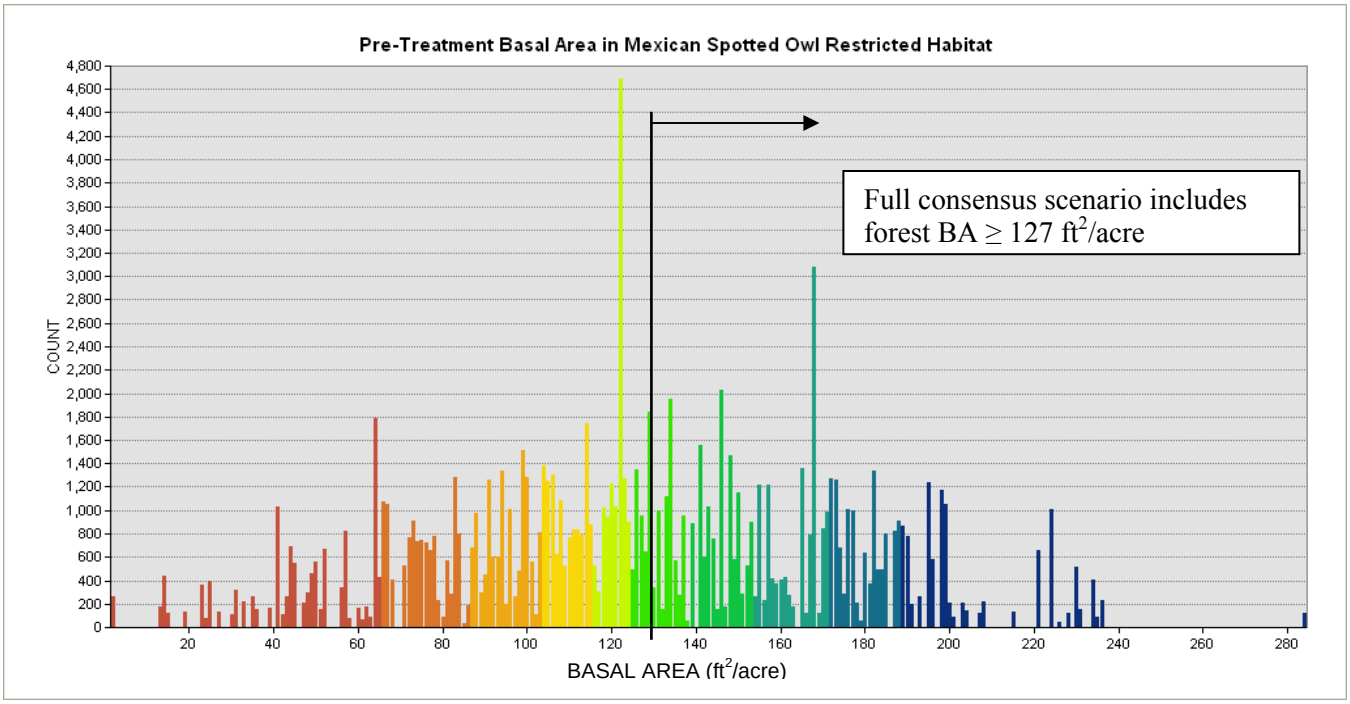


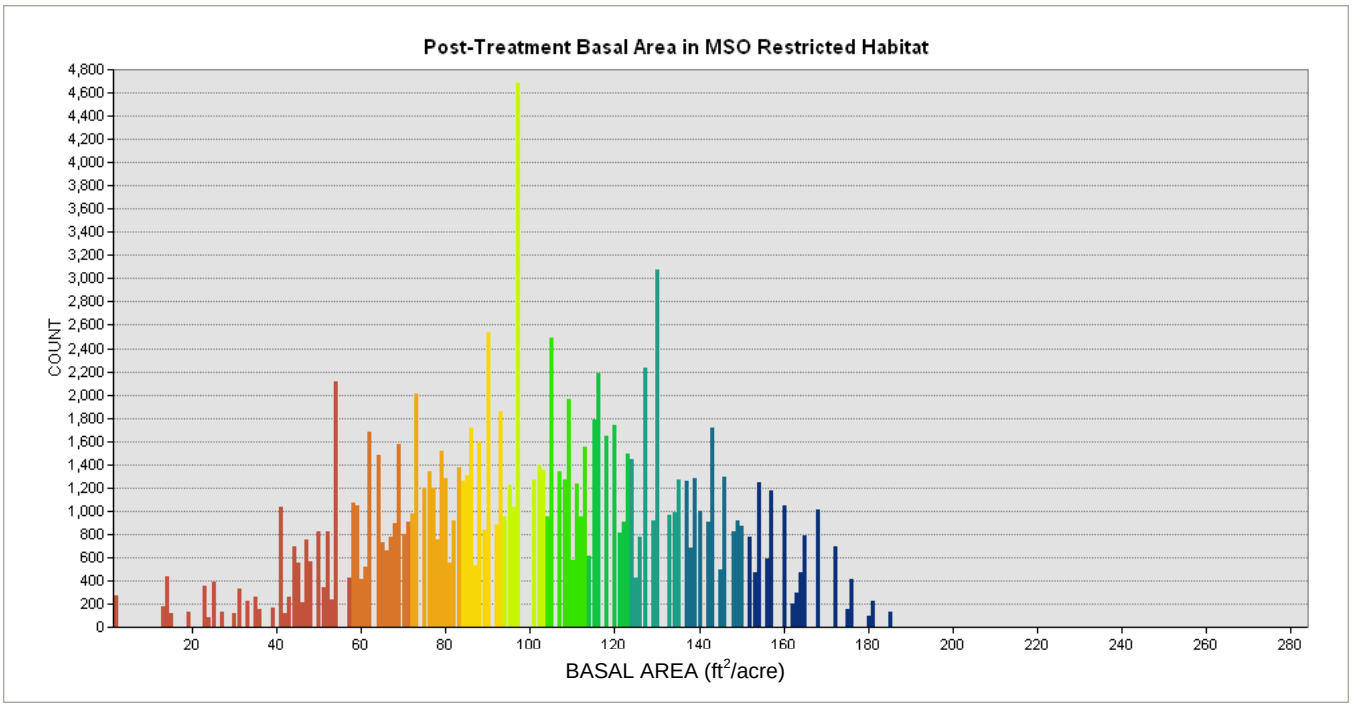


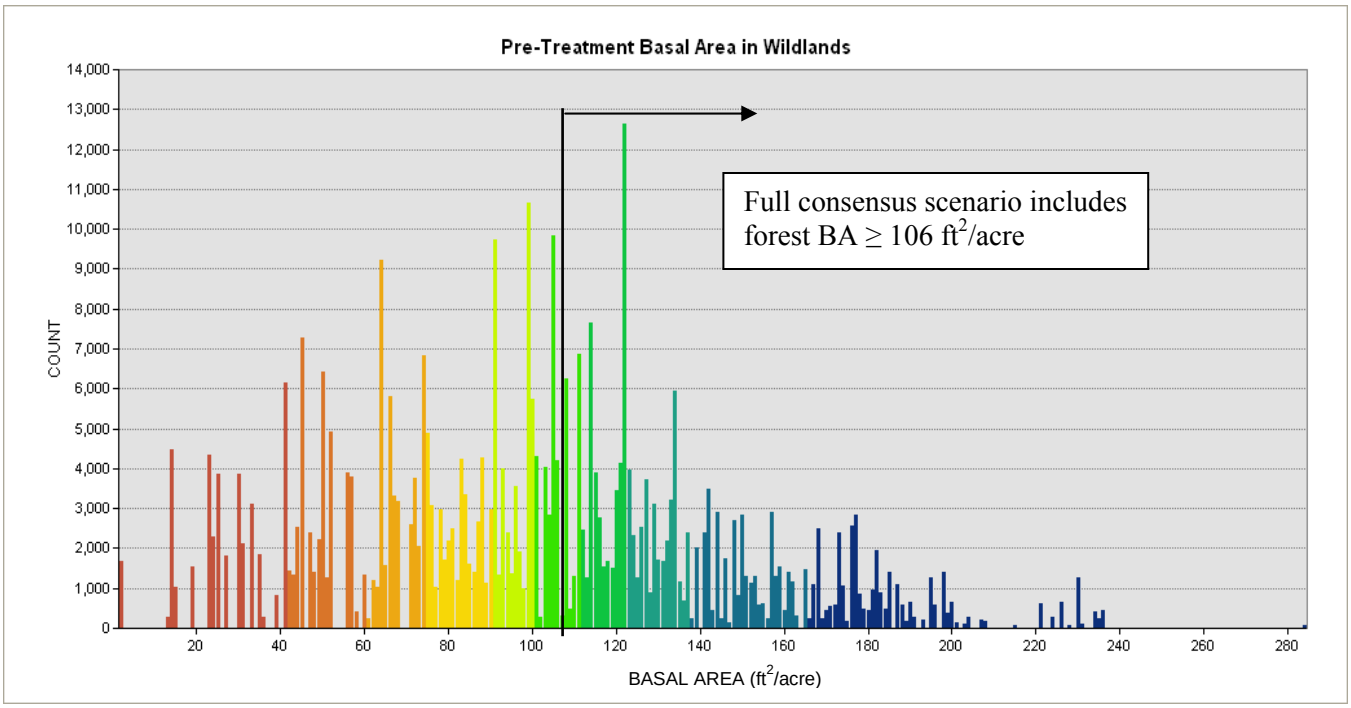
Note: Charts on first 2 pages include areas deemed not a source of wood supply to provide an overall summary for the analysis area. These areas are not included in the distributions on all other pages of this appendix as post-treatment conditions were not assessed in these areas.

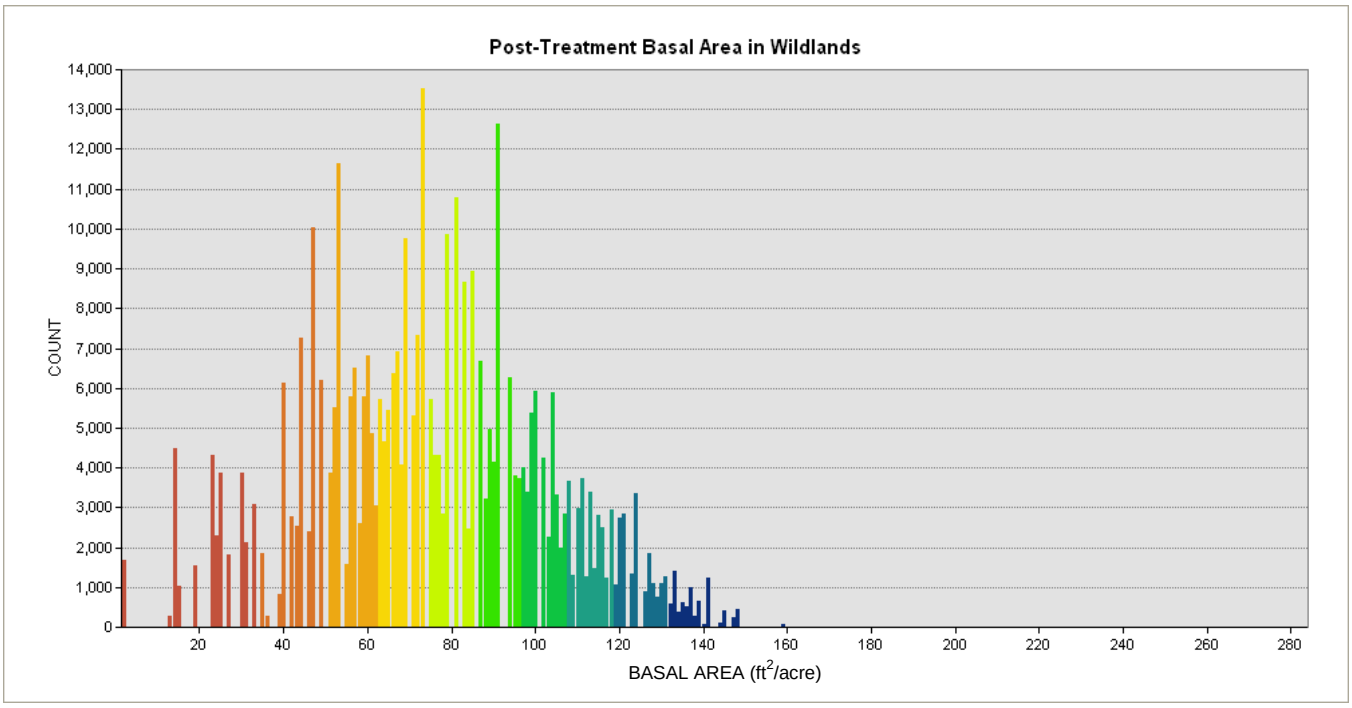

Pre-Treatment Basal Area, Full Analysis Area (ft2/acre)
COUNT
40,000
38,000
36,000
34,000
32,000
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
BASAL AREA (ft2/acre)

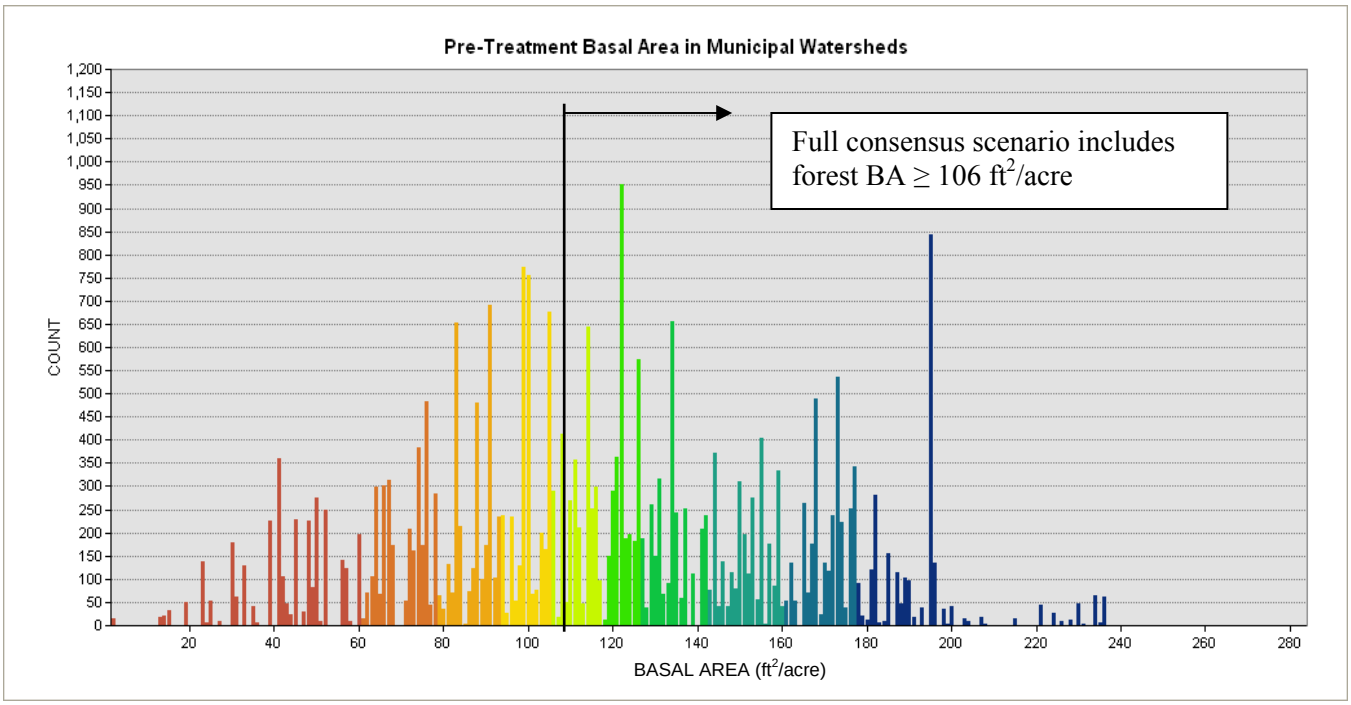

Post-Treatment Basal Area across Full Analysis Area (Majority Scenario)
COUNT
40,000
38,000
36,000
34,000
32,000
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
BASAL AREA (ft2/acre)

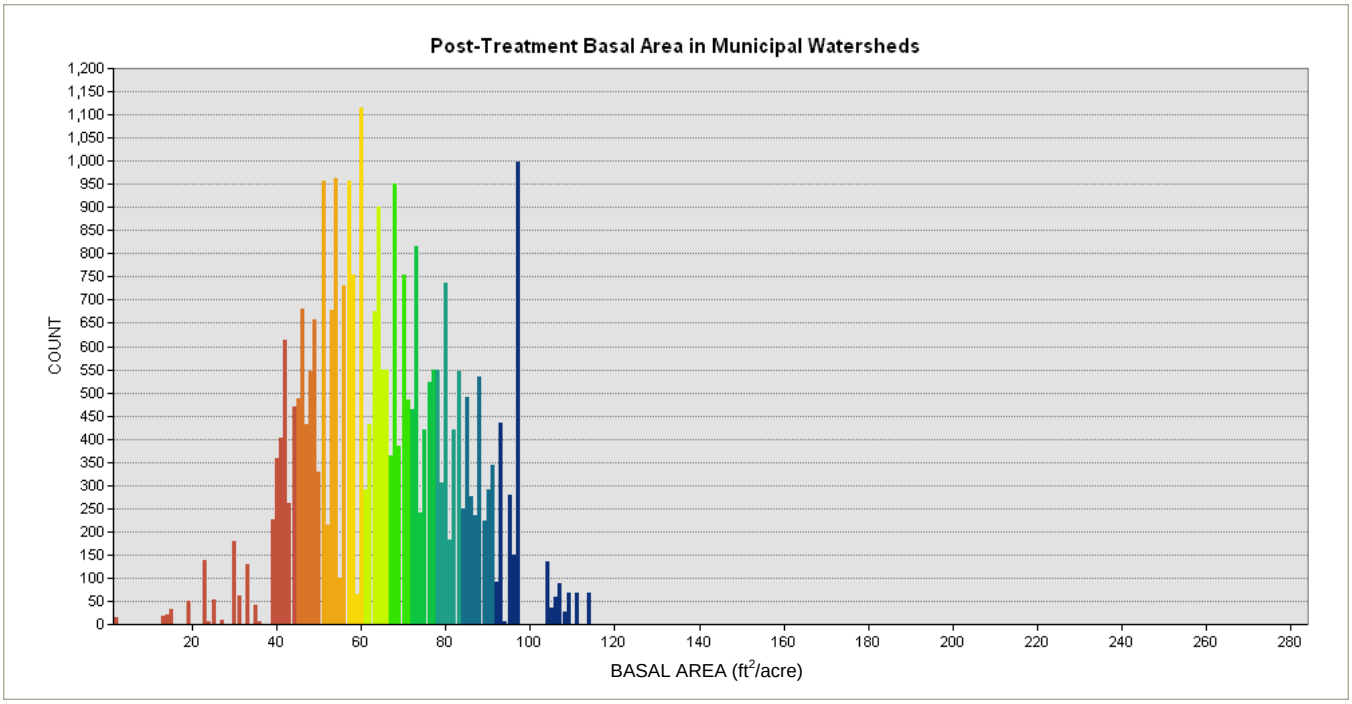

Pre-Treatment Basal Area in Mexican Spotted Owl Restricted Habitat
COUNT
BASAL AREA (ft²/acre)
Full consensus scenario includes forest BA ≥ 127 ft²/acre

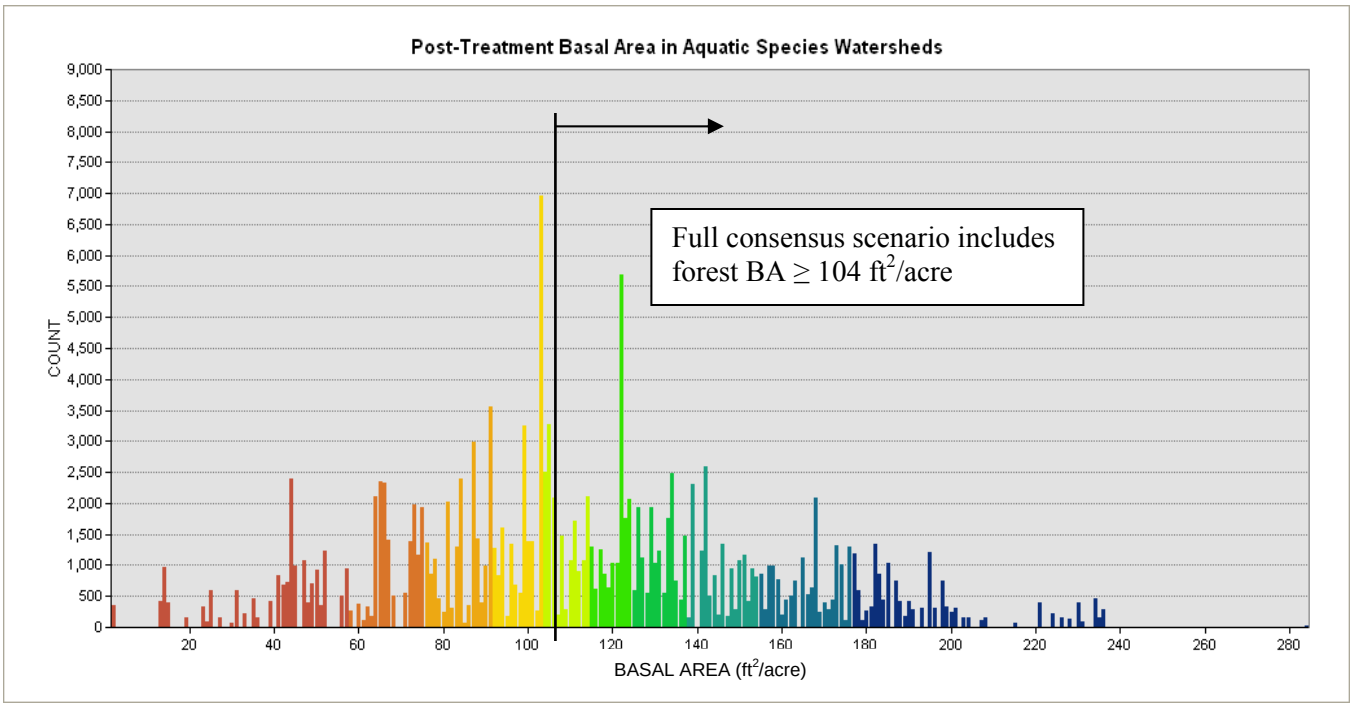

Post-Treatment Basal Area in MSO Restricted Habitat
COUNT
BASAL AREA (ft²/acre)

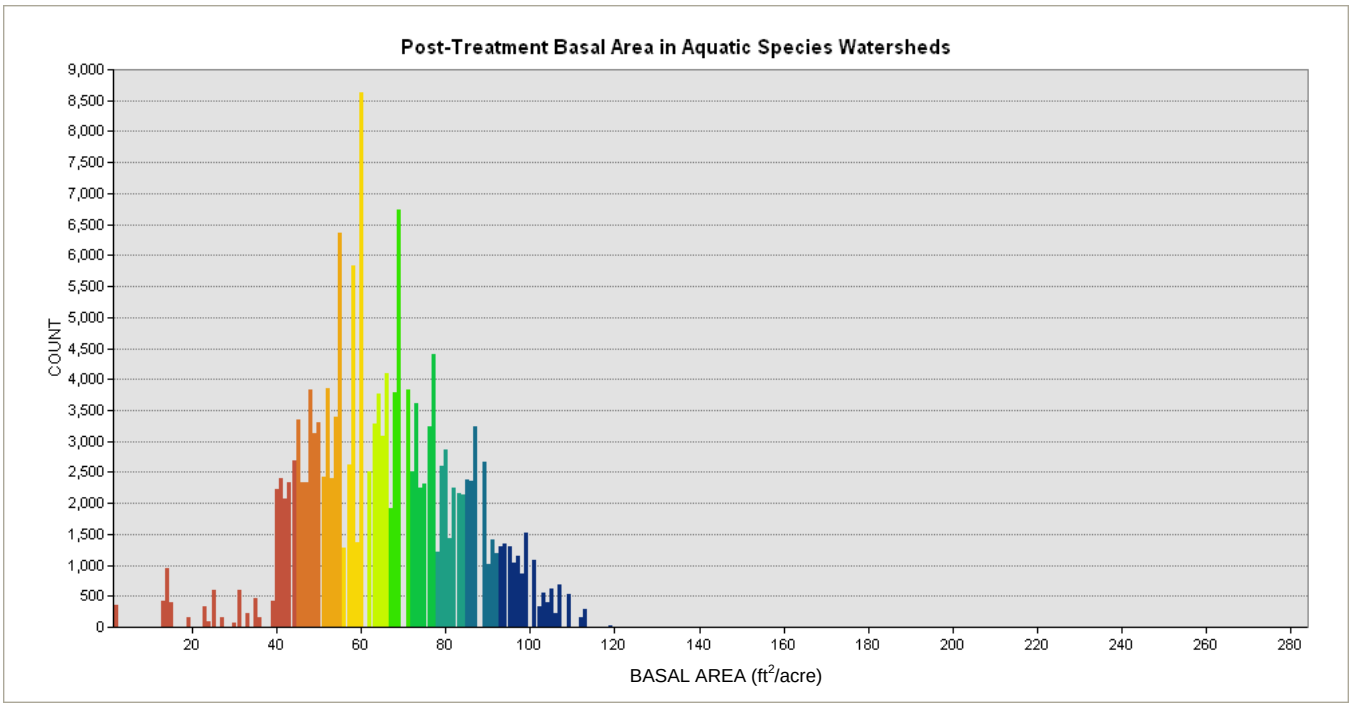

Pre-Treatment Basal Area in Wildlands
Full consensus scenario includes forest BA ≥ 106 ft²/acre
COUNT
BASAL AREA (ft²/acre)

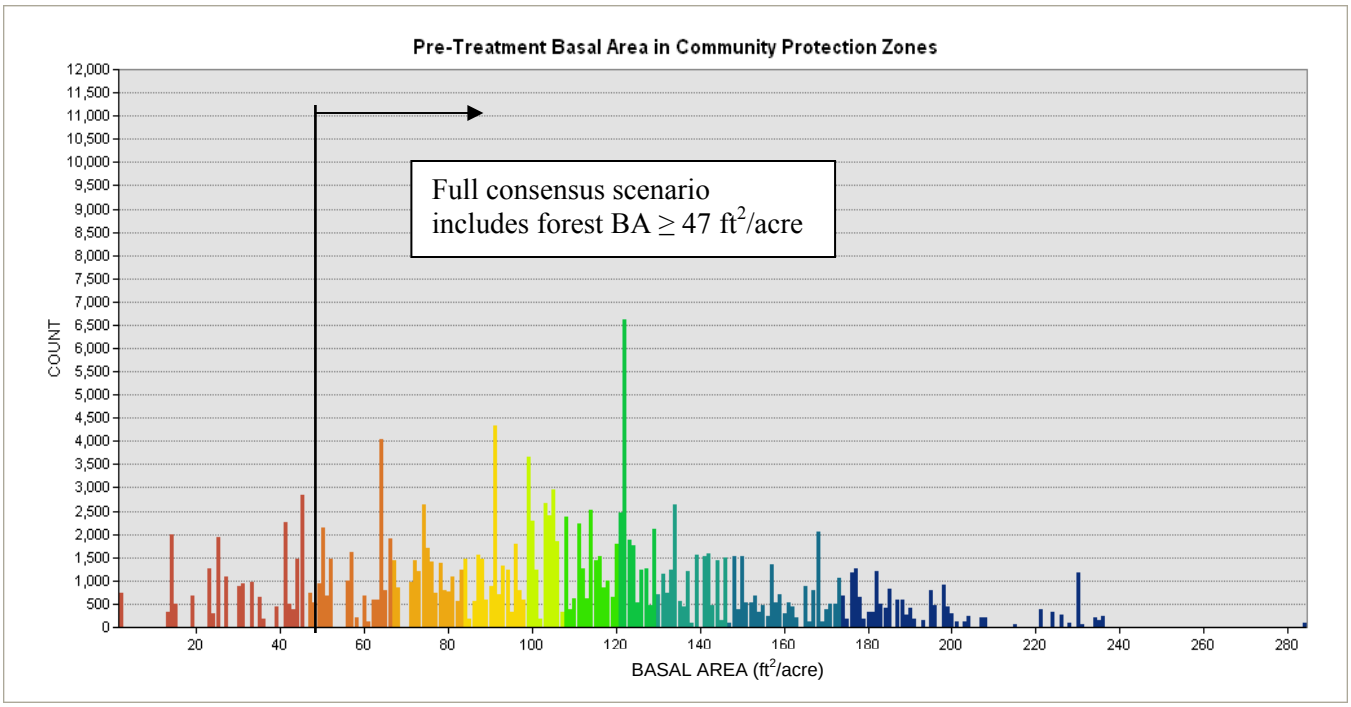

Post-Treatment Basal Area in Wildlands
COUNT
BASAL AREA (ft²/acre)

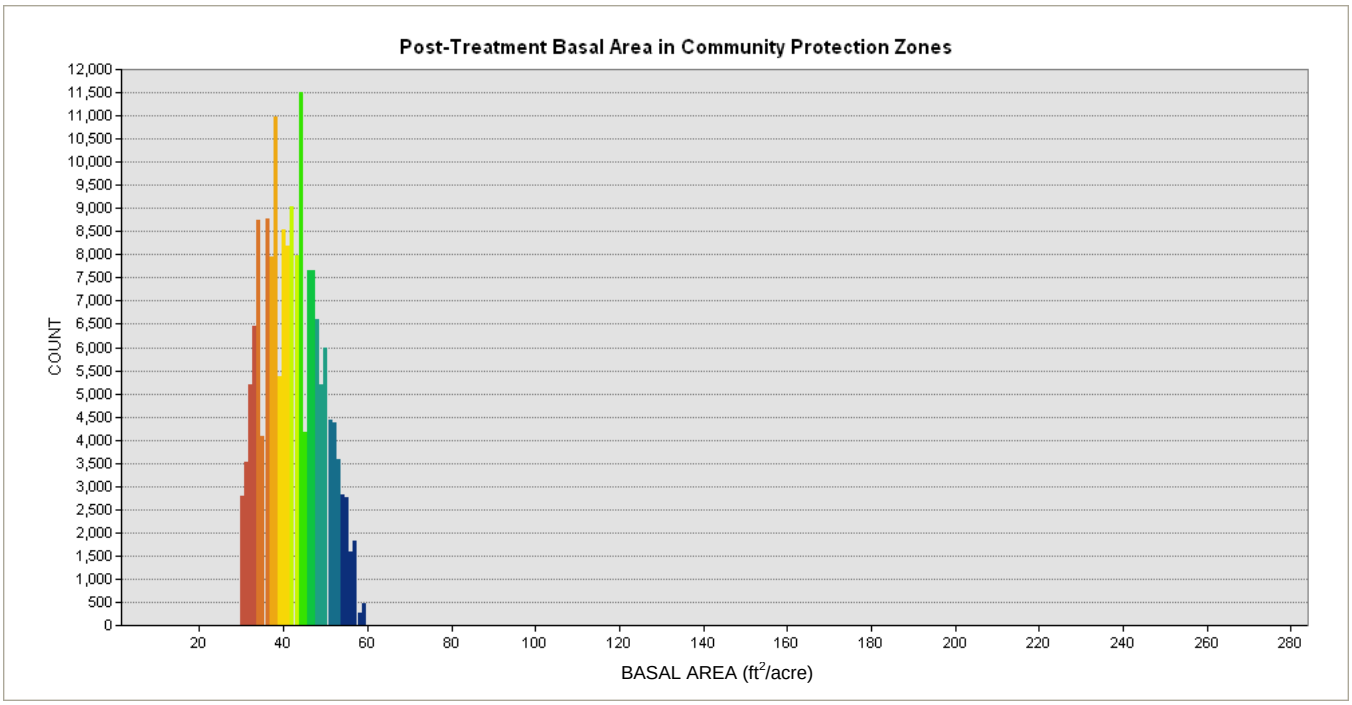

Pre-Treatment Basal Area in Municipal Watersheds
Full consensus scenario includes forest BA ≥ 106 ft²/acre
COUNT
BASAL AREA (ft²/acre)


Post-Treatment Basal Area in Municipal Watersheds
COUNT
BASAL AREA (ft²/acre)


Post-Treatment Basal Area in Aquatic Species Watersheds
COUNT
BASAL AREA (ft²/acre)
Full consensus scenario includes forest BA ≥ 104 ft²/acre


Post-Treatment Basal Area in Aquatic Species Watersheds
COUNT
BASAL AREA (ft²/acre)


Pre-Treatment Basal Area in Community Protection Zones
Full consensus scenario includes forest BA ≥ 47 ft²/acre
COUNT
BASAL AREA (ft²/acre)


Post-Treatment Basal Area in Community Protection Zones
COUNT
BASAL AREA (ft²/acre)

Joe Crouse
10-22-2007
ERI

Summary of Presettlement Tree Densities in Southwestern Ponderosa Pine

Site	TPA	TPA-Range	BA/Acre	BA/Acre-Range	Reference
Bar-M, Coconino N.F., AZ	23				1
Camp Navajo, AZ	26	10-141	51	0-170	2
Carson N.F., NM	37	26-47			3
Coconino N.F., AZ	27				3
Ft. Valley, Coconino N.F., AZ	13				4
Grandview, GCNP, Kaibab N.F., AZ	26	0-116	34	0-96	5
Gus Pearson Natural Area, Coconino N.F., AZ	23		18	3-37	6
Kaibab (Tusayan) N.F., AZ	35				3
Mt. Trumbull, AZ	15	0-51	38	0-139	7
North Kaibab R.D., Kaibab N.F., AZ	56				8
North Kaibab R.D., Kaibab N.F., AZ	43	40-45			9
Powell Plateau, GCNP, AZ	62	8-262	78	20-337	5
Zion N.P., UT	14	3-25			10
Swamp Ridge, GCNP, AZ	53	8-106	93	24-216	5
White Mountains, Apache-Sitgreaves N.F., AZ	40	35-45			11
Woolsey Plots, AZ and NM (average of 15 sites)	47	8-90	58	1-196	12

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Appendix E. Wood Supply Working Group Meeting Handout on Nov. 29, 2007 with Grand Canyon Trust Environmental Assessment Analysis

Projects(25)	Project Area	Treatment Area	Acreage PIPO	Acreage burn only	Why	(PIPO) not thinned	%Pipo not thinned	%treatment area not thinned	%project area burned	%treatment area burned
Eastside	22,000	19,977	16,776	12,356	No reason given	12,356	74%	62%	56%	62%
MormonLk.	2,831	2,831	2,831	313	MSO	313	11%	11%	11%	11%
Kachina	10,417	6,229	8,418	1,429	MSO, steep slopes	1,429	17%	23%	14%	23%
MundsPark	2,980	2,980	2,950	1,988	No reason given	1,998	68%	67%	67%	67%
Mountainaire	16,603	13,979	12,958	1,476	Steep slope; DFC's	1,476	11%	11%	9%	11%
RockyPark	13,878	13,678	11,282	8,000	DFC's	8,000	71%	58%	58%	58%
WoodyRidge	31,000	11,544	26,014	2,945	No reason given	2,945	11%	26%	10%	26%
Smith/Schultz	11,827	11,700	9,747	700	DFC's, steep slopes	1,103	11%	9%	6%	6%
UpperBeaver	49,123	44,694	41,922	30,414	Broadcast &maintenance	27,072	65%	61%	62%	68%
Victorine	19,915	8,678	10,661	6,922	839prev.treated;DFC's	6,922	65%	80%	35%	80%
Huffer	1,146	1,146	1,146	-	NA	-	0%	0%	0%	0%
ElkPark	6,886	6,886	6,485	1,700	Steep slope; DFC's	1,785	28%	26%	25%	25%
EastClearCreek	70,000	16,228	56,116	-	NA	-	0%	0%	0%	0%
Ft.Valley	9,100	6,960	7,281	1,800	Steep slope; DFC's	2,900	40%	42%	20%	26%
BlueR.MSO	16,282	16,282	14,817	2,399	No reason given	8,124	55%	50%	15%	15%
ChittyCreek	14,000	13,076	4,972	12,600	Steep slope; DFC's	11,676	89%	89%	90%	96%
Greer	24,092	19,629	18,636	-	NA	-	0%	0%	0%	0%
EagerS	21,779	17,543	7,946	3,233	Steep slope; DFC's	3,233	41%	18%	15%	18%
Nutrioso	41,768	36,166	31,964	7,590	Steep slope; DFC's	7,590	24%	21%	18%	21%
LongJim	1,375	1,375	1,074	462	Steep slope	662	62%	48%	34%	34%
Twin	14,900	14,900	9,834	14,518	Fuel reduction	14,518	97%	97%	97%	97%
JacobRyan	35,946	33,103	32,142	9,149	Fuel reduction	9,149	28%	28%	25%	28%
EastRim	17,216	9,630	4,791	1,440	Fuel reduction	4,307	90%	45%	8%	15%
Dogtown	8,209	7,317	6,689	2,000	Steep slope	2,250	34%	31%	24%	27%
City	12,403	12,359	10,369	3,263	Fuel reduction	3,780	36%	31%	26%	26%
							41%	37%	29%	34%
Two more from ForestERA										
Nagel								31%		31%
LosBurros								18%		16%
								36%		**33%**

Appendix F. Tree bole and crown biomass estimates in oven dry tons[1] for the consensus and majority scenarios within each landscape management area.

Landscape zone	Tot. stem tons	Tot. crown tons	Wood supply (ft^3)	Total area	Ave stem tons/ac	Ave crown tons/ac
Consensus scenario						
Community protection	4,867,751	1,451,606	368,975,519	314,017	15.5	4.62
MSO restricted habitat	749,769	223,829	56,832,525	113,076	6.6	1.98
Municipal watersheds	494,040	148,874	37,448,212	34,471	14.3	4.32
Aquatic species watersheds	2,501,664	745,835	189,626,094	187,157	13.4	3.99
Wildlands	2,564,987	763,374	194,426,007	338,486	7.6	2.26
Sum	11,178,211	3,333,518	847,308,357	987,206	11.3	3.38
Majority scenario						
Community protection	4,899,755	1,461,340	371,401,419	335,206	14.6	4.36
MSO restricted habitat	1,103,524	329,499	83,647,154	225,773	4.9	1.46
Municipal watersheds	622,778	188,016	47,206,561	58,031	10.7	3.24
Aquatic species watersheds	3,195,876	953,205	242,247,408	323,531	9.9	2.95
Wildlands	3,572,698	1,063,201	270,810,528	718,927	5.0	1.48
Sum	13,394,632	3,995,261	1,015,313,070	1,661,467	8.1	2.40

[1]A factor of 0.0758 was used to convert from oven dry tons to MCF

Appendix G. USDA Forest Service timber cruise data from White Mountain Stewardship Project tree thinning contracts on the Apache-Sitgreaves National Forests. Data were provided to us by Bob Taylor from the Apache-Sitgreaves National Forests.

Steward contract	Acres	Acres thin[1]	Thin residue[2]	ST & RW residue[3]	Total merch.[4]	Ave merch./ac	Residue/ac	Ave merch./ac[5]
Year 2004	`		green tons	green tons	green tons	green tons/ac	green tons/ac	Ft^3
Alpine WUI 2	426	426	1,077	3,940	11,466	26.9	11.8	897.2
Little	635	430	662	1,458	3,735	5.9	3.3	196.1
Mineral A	1,763	1,370	3,699	18,002	40,632	23.0	12.3	768.2
Ranch/Iris	817	817	4828	3,425	5,142	6.3	10.1	209.8
Sponseller[6]	1,244	0	0	4,611	9,924	8.0	3.7	265.9
Whipple[6]	1,397	0	0	9,807	24,822	17.8	7.0	592.3
Little Springs	2,039	2,039	30,822	24,679	60,453	29.6	27.2	988.3
Heber/Overgaard	2,276	2,276	9,559	5,872	9,147	4.0	6.8	134.0
Year 2005								
Mineral B1	1,157	1,022	3,050	10,208	23,733	20.5	11.5	683.8
Alpine 3,7,9	1,030	1,030	2,104	9,545	19,665	19.1	11.3	636.4
Woods Canyon[6]	448	0	0	2,033	5,856	13.1	4.5	435.7
Woodland/Camps	851	629	2,460	4,747	9,933	11.7	8.5	389.1
Greer A	1,377	1,377	4,311	9,010	24,294	17.6	9.7	588.1
Brookbank	1,258	936	6,867	1,872	4,119	3.3	6.9	109.1
Blue Ridge 2A	925	45	320	7,302	15,864	17.2	8.2	571.7
Year 2006								
Country Club	915	795	4,000	11,257	27,615	30.2	16.7	1006.0
Forest Lakes WUI	946	946	4,523	6,199	12,294	13.0	11.3	433.2
Dutch Joe A	356	150	573	3,578	7,881	22.1	11.7	737.9
Greer B	2,649	2,649	4,577	16,741	38,766	14.6	8.0	487.8
Alpine WUI 5,6	900	654	3,468	9,571	14,211	15.8	14.5	526.3
Dutch Joe B	810	810	2,414	9,292	21,294	26.3	14.5	876.3
Mineral B Hideaway	226	226	675	1,994	4,635	20.5	11.8	683.6
Mineral B2	766	766	2,286	6,758	15,711	20.5	11.8	683.7
Year 2007								
Greens Peak[6]	11	0	0	146	423	38.5	13.3	1281.8

Alpine WUI 4 & 8	1,188	1,188	5,194	10,404	25,308	21.3	13.1	710.1
Blue Ridge 2B	1,851	255	760	13,971	31,752	17.2	8.0	571.8
Greer D	1,827	1,299	1,688	12,905	32,067	17.6	8.0	585.1
Eagar South	1,095	1,095	2,933	3,834	15,705	14.3	6.2	478.1
Vincent A	1,170	1,170	5,346	12,239	31,338	26.8	15.0	892.8
Vincent B	813	813	3,716	8,782	22,527	27.7	15.4	923.6
Sum	33,166	25,213			**Ave**	17.2	10.7	611.5

[1]Acres of thinning for trees <5” dbh

[2]Green tons of tree residues from thinning trees <5” dbh that included tree boles, tops, limbs, foliage and bark.

[3]Green tons of saw timber (ST) and round wood (RW) tree residues from trees > 5” dbh that included tops, foliage and bark.

[4]Green tons of harvested material from merchantable portions of the tree bole.

[5] Cubic foot volume for ST and RW without residues (trees >5” dbh).

[6]Projects in which only trees > 5” dbh were harvested (i.e., no thinning residues from trees <5” dbh).

Pete Fulé
November 14, 2007

Fire Information for Wood Supply Analysis Group

A) Based on your experience in the field and with the literature, what would you consider to be the low- and high-end weather conditions (e.g., temperature, RH, windspeed) that would be "typical" or suitable for implementing prescribed fire in ponderosa pine-dominated stands?

A general guideline for southwestern ponderosa forests was presented in a widely used textbook by Pyne et al. (1996:574):

- Relative humidity 20-40%
- Temperature 40-60°F
- 10-hour fuel moisture (sticks between ¼ and 1" diameter) 8-12%
- Winds 5-15 mph in open areas, 2-7 mph in closed stands

Pyne et al. also reproduced a graphic illustration of prescription guidelines that suggested relatively more moist conditions:

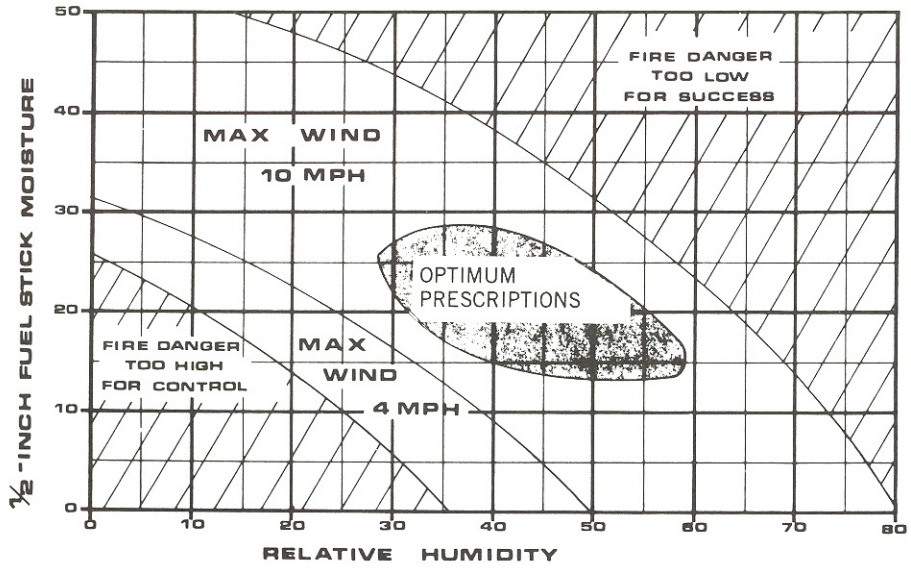

Figure 10.13. *Underburning: southwestern ponderosa pine. The prescription is here represented in unusual but graphic form.* From Southwest Interagency Fire Council (1968).

Managers can alter these parameters based on their experience. An example comes from a City of Flagstaff prescription which includes drier, warmer, and windier values for a very open, low-fuel thinned stand:

- Relative humidity 15-30%
- Temperature 60-75°F
- Winds 10-25 mph at 20´ above ground (equivalent to 4-10 mph at mid-flame height)

Conversely, if burning an area with substantial surface fuel and fuel ladders to a dense canopy, managers might select cooler conditions or forego burning until after tree thinning and/or surface fuel treatment was completed.

B) Under each of these sets of conditions (low and high), what is the range of basal area and tree density values, alone or in combination, which would permit the use of prescribed fire as a primary restoration and/or fuels reduction tool? We recognize that these values may be different in a restoration vs. fuels reduction context, so please provide ranges for each context, if necessary.

This question does not have a simple answer, for several reasons. First, nearly any southwestern ponderosa pine forest *could* be burned with prescribed fire. As an example, even the extraordinarily dense forest at the Chimney Spring interval burning site (up to 4,300 trees/acre) has been successfully burned many times. Second, even a very open, low-hazard forest *could not* be burned if it were adjacent to an area with high hazards or high values at risk. An example is that a manger might refrain from using fire even in low-density stands if they were located at the base of a steep canyon with many dead trees or with spotted owl nest sites, as is the case on north aspects at Walnut Canyon National Monument. Light grassy fuels can also be "flashy" and present hazards of high rate of spread and long flames, thus even open pine savannas can be considered to be hazardous fuels under certain conditions. Third, prescribed fire behavior is regulated not only by weather, fuel moisture, fuel type, and topography, but also by the way in which the fire is ignited. Perhaps the most common ignition method in the Southwest is strip headfires, but different fire behavior would be encountered under otherwise identical conditions if the fire were ignited by aerial ignition, backing fire, or ring burning.

Taking all of the above factors into consideration, it is clear that there can be no single guideline for stand conditions "which would permit the use of prescribed fire as a primary restoration and/or fuels reduction tool." However, it is also logical to suggest that *in many cases* there may be a rational basis for drawing distinctions about the use of prescribed fire. The following is simply my opinion about how to differentiate these conditions based on several criteria:

1. Does the subject stand or forest present a reasonably low risk of escaped fire or wildfire burning into the canopy due to dense canopy fuels or fuel ladders? I would answer this question by looking at the attributes of stands that are vulnerable to crownfire. In a statewide analysis of New Mexico forest data, Fiedler et al. (2002) classified forests with basal areas below 50-80 ft^2/acre as low hazard and those up to 90-110 ft^2/acre as moderate hazard, as measured by calculating crowning index windspeed values. Studies in northern Arizona indicated that stands averaging basal area of 81 ft^2/acre and 71 pines/acre had low crownfire hazard (Fulé et al. 2001a). Even higher values of 97 ft^2/acre and 98 pines/acre had acceptably low crownfire hazard—that is, fires were predicted to stay on the surface even under severe burning conditions (Fulé et al. 2001b, Appendix A). This line of reasoning leads to a relatively low-hazard stand condition of approximately $\leq$ 100 ft^2/acre and $\leq$ 100 pines/acre. Both attributes are important, because basal area is proportional to total biomass and

canopy fuel loading, while tree density is associated with fuel ladders. However, if it were to be necessary to choose only one attribute, the basal area is probably more important because it relates most closely to the ability of fire to spread through the tree canopies (canopy bulk density).

2. Is the subject stand located in a reasonably safe landscape context? Answering this question requires spatial data about the stand´s location and proximity to hazardous fuels and values at risk.
3. Does management exclusively or primarily with prescribed fire meet all the goals and constraints associated with the desired future condition of the subject stand? Answering this question also requires additional information about goals, social values, and other data.

The question referred to burning for "restoration and/or fuels reduction." There is no question that prescribed fire is an effective fuel reduction tool in ponderosa pine forests. Repeated prescribed burning (intervals ≤ 10 yr) reduces surface fuels (Covington and Sackett 1992) and burning was shown to protect many stands during the most severe fire in southwestern history, the Rodeo-Chediski fire (Finney et al. 2005, Strom 2005). However, there is less evidence indicating that prescribed burning can serve as an effective *ecological restoration* tool in forests that are substantially more dense than historical reference conditions, because established pine trees are resistant to mortality from light surface fires. Repeated fires at Chimney Spring led to negligible thinning of excess young trees, although deliberate use of ring burning fire patterns created higher local mortality (Sackett et al. 1996). Free-burning wildland fire use fires at Grand Canyon National Park in 2003 did exert a substantial thinning effect in ponderosa pine forests invaded by white fir (Fulé and Laughlin 2007). Thus the evidence suggests that effective tree thinning would require relatively intense burning. Such fire behavior would probably not be desirable near communities or other values at risk, though in other places it may be acceptable. It is worth noting that the rough guidelines of ≤ 100 ft^2/acre and ≤ 100 pines/acre are still 40-250% higher than estimates of pre-European settlement forests (Appendix B).

C) I would add that we would like to include the same two questions applied to "Fire Use Fire" conditions. That is, Rx fire conditions might be very conservative, whereas if one or more of the forests implement "fire use for resource benefit" programs on a larger landscape, the prescription might be less conservative, allowing for greater variability in acceptable conditions, and hence, more acres in fire management.

The information presented in the preceding sections is also applicable to Wildland Fire Use (WFU), but some additional considerations may be relevant. The premise of the question, that a greater variability in fire behavior might be acceptable in WFU, probably depends on the specific circumstances. Most agencies with approved WFU plans to date have adopted a zoning approach, meaning that certain areas of the wildlands they administer are considered suitable for WFU and others are not. The WFU zones tend to be in the backcountry, where there may be reduced concerns about smoke impacts, aesthetics, and risks of escaped fires damaging developments. Therefore, to the extent that acceptable fire behavior may vary over a wider range, this variability may be more a reflection of the nature of the WFU zone than an inherent characteristic of WFU itself.

Probably the best example of WFU (previously "prescribed natural fire") in the Southwest comes from the Gila Wilderness and adjacent lands, where free-burning fires are permitted to proceed for extended periods and a wide range of fire behavior is considered acceptable. The Gila Wilderness exemplifies the natural role of fire in modern times. However, the Gila also has certain unusual qualities: the lands are mostly designated Wilderness; populations are low, rural, and socially accepting of fire; developed values at risk are minimal; few critical airsheds lie downwind; and the forest itself has had relatively fewer deleterious impacts since European settlement, with little roading or logging and a number of fires in the twentieth century (Rollins et al. 2001). Elsewhere in the Southwest, only the North Kaibab Ranger District and North Rim of Grand Canyon National Park share most of these attributes. Other forests tend to have substantial private inholdings and developments, nearby urban populations with low smoke tolerance, nearby critical airsheds, and substantial forest degradation over the past 100+ years resulting in dense stands of young trees, forest floor fuel buildup, and invasive exotic species. Both the management goals and the methods selected to attain these goals are likely to differ between the Gila Wilderness and the Coconino National Forest, for example.

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Appendix A: Summary of Pre- and Post-Treatment Forest Structure at Ecological Restoration Experimental Sites

Pete Fulé
September 26, 2007

Site	Treatment	Pretreatment		Posttreatment		Reference	Note
		Trees per Acre	Basal Area (ft^2/acre)	Trees per Acre	Basal Area (ft^2/acre)		
Mt Trumbull	Full Restoration	554.4	148.5	127.5	77.1	1	1
GPNA	Full Restoration	1253.8	150.3	61.5	46.2	2, 3, 4	2
Ft Valley	Full Restoration	386.5	151.5	56.8	67.8	5	2
Ft Valley	Intermediate Thinning	603.7	167.7	68.8	77.7	5	2
Ft Valley	Reduced Thinning	422.1	148.5	98.3	97.2	5	2
Tusayan	Full Restoration	541.3	76.2	62.2	27.0	6	1
Tusayan	Minimal Thinning	1187.8	98.0	276.7	58.4	6	1
Average	**Full Restoration**	**684.0**	**131.6**	**77.0**	**43.0**		
Average	**All Treatments**	**707.1**	**134.4**	**107.4**	**57.9**		

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Notes:

1. Ponderosa dominated, some Gambel oak.
2. Pure ponderosa pine.

Appendix B: Summary of Presettlement Tree Densities in Southwestern Ponderosa Pine

Joe Crouse
10-17-2007

Site	Trees per Acre	Reference
Bar-M, Coconino N.F., AZ	23	1
Camp Navajo, AZ	26	2
Carson N.F., NM	26-47	3
Coconino N.F., AZ	27	3
Ft. Valley, Coconino N.F., AZ	13	4
Grandview, GCNP, Kaibab N.F., AZ	26	5
Gus Pearson Natural Area, Coconino N.F., AZ	23	6
Kaibab (Tusayan) N.F., AZ	35	3
Mt. Trumbull, AZ	14	7
North Kaibab R.D., Kaibab N.F., AZ	56	8
North Kaibab R.D., Kaibab N.F., AZ	40-45	9
Powell Plateau, GCNP, AZ	62	5
Zion N.P., UT	3-25	10
Swamp Ridge, GCNP, AZ	53	5
White Mountains, Apache-Sitgreaves N.F., AZ	35-45	11
Woolsey Plots, AZ and NM (average of 15 sites)	47	12

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Appendix I. Potential Follow-on Studies to Wood Supply Analysis

In the event that follow-up projects emerge as a result of this study, Working Group members and ForestERA recommend the following:

1. Conduct fire spread model analyses (e.g., strategically placed treatments), among other collaborative prioritization analyses, to inform the appropriate spatial and temporal priorities for fuel reduction treatments.
2. Include forest growth in supply estimates based on collaboratively derived priorities.
3. Use fire models to identify thresholds for prescribed burning and wildland fire use as an initial treatment.
4. Evaluate patch quality and habitat connectivity for a suite of wildlife species in a post-treatment scenario. Conduct connectivity analyses for those species to evaluate the potential for distributional shifts of behavioral movements in response to patch treatments.
5. Refine this regional-scale analysis down to a finer scale.
6. Analyze additional Environmental Assessments to more precisely evaluate the reasons why and where certain treatments (e.g., mechanical thinning, fire-only) are planned.
7. Conduct more detailed estimates of biomass (in tons) as was done in the wood supply analysis for wood by-product volumes.
8. Improve Forest Service roads layer.