DESIRED CONDITION WORKSHOP AGENDA
OCTOBER 26-27, 2011

Day 1: October 26	**Cibola County Federal Bldg. (County Convention Room)** **515 West High Street/ Grants, NM**	
0800-0815	**Welcome and Introductions**	**ERI**
0815-0840	**Regional Forester Perspective on DC, Landscape Scale Restoration**	**Corbin**

- **Why Desired Conditions dialogue? Why now?**
- **Expectations for the workshop**
- **R3 Desired Conditions: why and how we are using them?**
- **Adaptive nature of Desired Conditions**
- **Today's focus: the scientific basis for the ecological DCs consideration of the socio-economic values that influence them**

0840-0930	**Setting the Stage for Desired Condition Dialogue**	**Wally**

- **Current conditions: how did we get here, where are we headed?**
- **Ecological restoration: what is restoration and the science that supports it?**
- **Sustainability: key elements of self-regulating landscapes**
- **Benefits of restoration**
- **Resilience to climate variability, change, and other stressors**

0930-0945	**Break**	
0945-1045	**Desired Condition Description**	**DC Team**

What are Desired Conditions, how they were developed, why we need desired conditions

- **Vision of Desired Conditions**
- **Desired Conditions are designed to achieve restoration**
- **Progress toward Desired Conditions is a measure of success**

	Description of Desired Conditions	
1045-1115	Desired Condition Panel	Corbin, Wally, Desired Condition Team
1115-1130	Description of the field visits (maps, handouts)	ERI
1130-1145	Lunch (provided) & load vans	
1145-1235	Travel to Blue Water Site	
1235-1430	Review Blue Water Sites (2 stops)	
1430-1530	Return to Grants, NM	
1530-1800	Travel to Springerville, AZ	All

Day 2: October 27, 2011- Apache-Sitgreaves National Forest, Arizona

0745	Assemble at A-S NF Supervisor's Office 30 South Chiricahua Drive, Springerville, AZ	All
0800-0850	Travel to Campbell Blue (Stop #1)	
0850-1000	Review Campbell Blue Site	
1000-1020	Travel to Forest Rd. 249 (Rest stop)	
1040-1100	Travel to Big Lake (Mixed conifer) site	
1100-1135	Review Big Lake Mixed Conifer Site (Stop #2)	
1135-1200	Travel to Eager South Overlook	
1200-1230	Lunch @ Overlook (Provided)	
1230-1310	Discussion of Eagar South Restoration sites (Stop #3)	
1315-1400	Point of the Mountain Site (Stop #4)	
1400-1500	Brown Sawmill site (Stop #5)	
1500-1630	Wrap-up & return to Springerville	

SETTING THE STAGE FOR DESIRED CONDITION DIALOGUE

DESIRED CONDITION WORKSHOP

October 26-27, 2011

PURPOSE OF WORKSHOP

Initiate a Desired Condition dialogue related to ponderosa pine and dry mixed conifer forest types to guide landscape-scale restoration and inform Forest Plan revision in Region 3.

OBJECTIVES OF WORKSHOP

1. Begin a dialogue about desired conditions for Forest vegetation types
2. Share the Forest Service's Desired Condition perspective
    a. Share the current Desired Conditions for ponderosa pine and dry mixed conifer.
    b. Explain why they are important to our landscape scale restoration efforts.
3. Present a clear picture of Desired Conditions and gain a common understanding through field visits that illustrate Desired Conditions, function, and processes.
4. Hear social and scientific perspectives about desired conditions from other interested parties.
5. Explain how the Desired Conditions will be used in Forest Plan revision, and landscape and small scale project development.
6. Explain how the Desired Conditions can be used as a measure of success.

OVERVIEW OF DESIRED CONDITION

The desired conditions describe tree species compositions, densities, structural and age-class distributions, as well as spatial distribution of trees. Specific to some of the forest types (ponderosa pine and dry mixed conifer); the composition, location, and amount of grass/forb/shrub openings (the degree of openness) is described , as are the dimensions, spatial distributions, amounts and densities of snags, down logs, woody debris, and various natural processes such as nutrient cycling, trophic interactions, fire, insect, and diseases. Because the desired conditions incorporated forest dynamics – the spatial and temporal changes resulting from vegetation growth and succession and periodic resetting of these by natural and human-caused disturbances such as fire, wind, insects, diseases, and tree harvests – they describe forest and woodlands as shifting mosaics of different vegetation structural (age) classes and/or successional stages. This dynamic is described at three spatial scales (fine scale, mid-scale and landscape scale) and incorporate six forest ages classes (seedling, saplings, young, mid-aged, mature, and old forest). Refer to the descriptions of Ponderosa Pine and Dry Mixed Conifer desired conditions in attachment A. Refer to Tables 1 and 2 for comparisons of current and desired forest conditions for ponderosa pine and dry mixed conifer by characteristic and function.

SCIENTIFIC BASIS OF DESIRED CONDITION

The process used to develop the desired conditions involved syntheses of scientific information on habitats of native plants and animals, their food webs, the ecologies of the dominant over story and understory vegetation and the types, frequencies, and intensities of natural and anthropogenic disturbances typical of the forest types. As a result of (1) the synthetic process used to develop the desired conditions, (2) the breadth of ecological knowledge on the composition, structure, and ecological function included in the syntheses, and (3) the incorporation of natural disturbances that shaped the historic conditions within ecosystems, the desired conditions fall within the range of natural conditions of each forest type. This suggests that the desired conditions are both attainable and sustainable. Natural conditions provide a good estimate of a functioning and sustainable system and are a powerful basis for evaluating desired condition. The scientific literature supporting the key characteristics and functions of these desired conditions are included in the summary of supporting science document attachment B.

BENEFITS OF DESIRED CONDITION

Desired conditions describe the characteristics necessary to restore and sustain ecosystems including structure, composition, landscape patterns, and processes and provide for habitats of native wildlife species including the Mexican spotted owl and the northern goshawk. They promote ecosystem functionality, hydrological function, reduce fire hazard, and provide for abundant and well-distributed old growth as a sustainable forest component.

RELATIONSHIP BETWEEN FOREST PLANS AND DESIRED CONDITION

Desired conditions are the foundation of current Forest Plan development. They describe the goals and outcomes of forest management and ecological, social, and economic attributes that a forest can achieve over time. Desired conditions guide the development of future projects and activities and establish a means for determining the consistency of projects with Forest Plans. Desired conditions, together with the other Plan components, constitute a framework for sustainability and should clearly articulate management intent over the life of the Plan.

ADAPTIVE NATURE OF DESIRED CONDITION

Desired conditions are a work in progress and will change over time as new scientific information is developed and as we adapt them to new monitoring information from ongoing efforts such as the Four Forest Restoration Initiative.

DESIRED CONDITION EXPRESSED AS A RANGE ACROSS THE REGION

Desired condition characteristics are expressed in ranges, as opposed to traditional target metrics, to account for natural variation in composition and structure that occurs within a vegetation type as well as for social and economic considerations. Desired conditions will vary somewhat within a vegetation type due to spatial variability in soils, elevation, or aspect.

Table 1: Comparison of Current and Desired Condition by Forest Characteristic (Ponderosa Pine and Dry Mixed Confer Forest Types)

Characteristic	Current condition	Desired condition
Species composition	PP type: ponderosa pine and other minor species, little if any oak and other shade intolerant species Dry MC type: species composition shifting towards shade-tolerant species (white-fir, blue spruce). Shade intolerant species becoming sub-dominant.	PP type: ponderosa pine is dominant, but other shade intolerant species are present depending on appropriate local site conditions (ie: juniper species, oak and other hardwood species) Dry MC type: dominated by shade intolerants species (ponderosa pine, Douglas-fir, white pine, aspen), other species present but are sub-dominant
Forest tree density	Most sites > 80 sq ft of ba/acre	PP type: 20-80 sq ft of ba/acre Dry MC type: 30-100 sq ft of ba/acre
Spatial distribution	Typically even to random spacing, little in the way of tree groups	Groups of trees separated by forest openings
Forest openings occupied by grass/forb/shrub vegetation	Typically few openings with limited grass/forb/shrub vegetation	Openings are generally from 30% to 60% of the area occupied by grass/forb/shrub veg: 10% and 70% representing the extremes
Tree ages	Typically single- and two- aged forests = even-aged	All ages present, young, mid and old = uneven-aged
Habitats, biodiversity and food webs	Typically little biodiversity, primarily conifer tree cover, limited understory herbaceous/shrub composition due to closed canopy	Much greater biodiversity, multiple tree species; oak, aspen, and other hardwoods and broad number of herbaceous grass/forb/shrub species due to openings
Snags/acre, down woody material	Typically < 2/acre, generally greater than 7 tons per acre	1-2 Snags/Acre 18 inches DBH PP type: 3-7 tons per acre Dry MC type: 5-15 tons per acre

Note we are not likely to achieve desired condition in one treatment. It may take many years or even decades depending on how departed current condition is from desired.

Table 2: Comparison of Current and Desired Condition by Forest Function (Ponderosa Pine)

Characteristic	Current Condition	Desired Condition
Fire Behavior/frequency and effects Surface fire, Crown fire potential passive and active	Fires infrequent become uncharacteristic resulting in active crown fire on a large scale (high mortality): limited nutrient cycling	Fires frequent, primarily surface fire, do not spread between tree groups as crown fire (low mortality): promotes nutrient cycling
Hydrologic function	Typically little precipitation penetration of closed canopy, most lost to evaporation and transpiration	Precipitation reaching the forest floor, improved infiltration, surface flow, soil moisture, herbaceous cover.
Visual attributes	Limited visual diversity due to dense even-aged continuous tree stands, limited viewing opportunities.	Improved visual diversity due to openness between the groups of trees. Greater variety due to tree age diversity and density variation
Sustainability and resilience	Limited resilience to insects, diseases, uncharacteristic fire, climate variability, change, and other stressors. Not sustainable over time	Increased resilience to insects, diseases, uncharacteristic fire, and climate variability, change and other stressors. Sustainable over time.

ATTACHMENT A

Ponderosa Pine Forest Desired Conditions

General Description

The ponderosa pine forest vegetation community includes two sub-types: Ponderosa pine bunchgrass and ponderosa pine Gambel oak. The ponderosa pine forest vegetation community generally occurs at elevations ranging from approximately 5,000 to 9,000 feet. It is dominated by ponderosa pine and commonly includes other species such as oak, juniper, and pinyon. More infrequently species such as aspen, Douglas-fir, white fir, and blue spruce may also be present, and may occur as individual trees. This forest vegetation community typically occurs with an understory of grasses and forbs although it sometimes includes shrubs.

Landscape Scale Desired Conditions (an assemblage of mid-scale units)

At the landscape scale, the ponderosa pine forest vegetation community is a composed of trees from structural stages ranging from young to old. Old growth is well distributed in the landscape and occurs as groups of old trees mixed with groups of younger trees, or occasionally as larger groups comprised of mostly old trees. The forest contains various stages of development (even temporary openings or groups of very young trees) to provide future old growth groups within the landscape. Forest appearance is variable but generally uneven-aged and open; occasional areas of even-aged structure are present. The forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably-sized openings of grass/forbs/shrubs vegetation associations similar to historic patterns. Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites. Size, shape, number of trees per group, and number of groups per area are variable across the landscape. In the Gambel oak sub-type, all sizes and ages of oak trees are present. Denser tree conditions exist in some locations such as north facing slopes and canyon bottoms.

The ponderosa pine forest vegetation community is composed predominantly of vigorous trees, but declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris (>3 inch diameter), all well-distributed throughout the landscape. Ponderosa pine snags are typically 18 inches or greater at DBH and average 1 to 2 snags per acre. In the Gambel oak subtype, large oak snags (>10 inches) are a well-distributed component. Downed logs (>12 inch diameter at mid-point, >8 feet long) average 3 logs per acre within the forested area of the landscape. Coarse woody debris, including downed logs, ranges from 3 to 10 tons per acre.

The composition, structure, and function of vegetative conditions are resilient to the frequency, extent and severity of disturbances and climate variability. The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, fire, and wind), including snags, downed logs, and old trees. Grasses, forbs, shrubs, and needle cast (fine fuels), and small trees maintain the natural fire regime. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Frequent, low severity fires (Fire Regime I) are characteristic in this type, including throughout goshawk home ranges. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

Mid-Scale Desired Conditions (an assemblage of fine scale units)

At the mid-scale the ponderosa pine forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The more biologically productive sites contain more trees per group and more groups per area, resulting in less space between groups. Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites. Tree density within forested areas generally ranges from 20 to 80 square foot basal area per acre.

The mosaic of tree groups generally comprises an uneven-aged forest with all age classes present. Infrequently patches of even-aged forest structure are present. Disturbances sustain the overall age and structural distribution.

Fires burn primarily on the forest floor and do not spread between tree groups as crown fire.

Forest structure in the wildland urban interface (WUI)[1] can have smaller, more widely spaced groups of trees than in the non-WUI areas.

[1] Note –each Forest needs to provide the definition for WUI that they are using.

Forest conditions in goshawk post-fledging family areas (PFAs) are similar to general forest conditions except these forests contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in goshawk foraging areas and the general forest. Goshawk nest areas have forest conditions that are multi-aged but are dominated by large trees with relatively denser canopies than other areas in the ponderosa pine type.

Fine Scale Desired Conditions (up to10 acres)

Trees typically occur in irregularly shaped groups and are variably-spaced with some tight clumps. Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking. Openings surrounding tree groups are variably-shaped and comprised of a grass/forb/shrub mix. Some openings contain individual trees. Trees within groups are of similar or variable ages and may contain species other than ponderosa pine. Size of tree groups typically is less than 1 acre, but averages .5 acres. Groups at the mid-aged to old stages consist of 2 to approximately 40 trees per group.

See photos below.

Photo 1: All tree ages represented; old growth as groups of old trees mixed with groups of younger trees. (ponderosa pine)

Photo 2: A group of old trees made up of two clumps; trees are variably spaced within the group and have interlocking crowns (ponderosa pine)

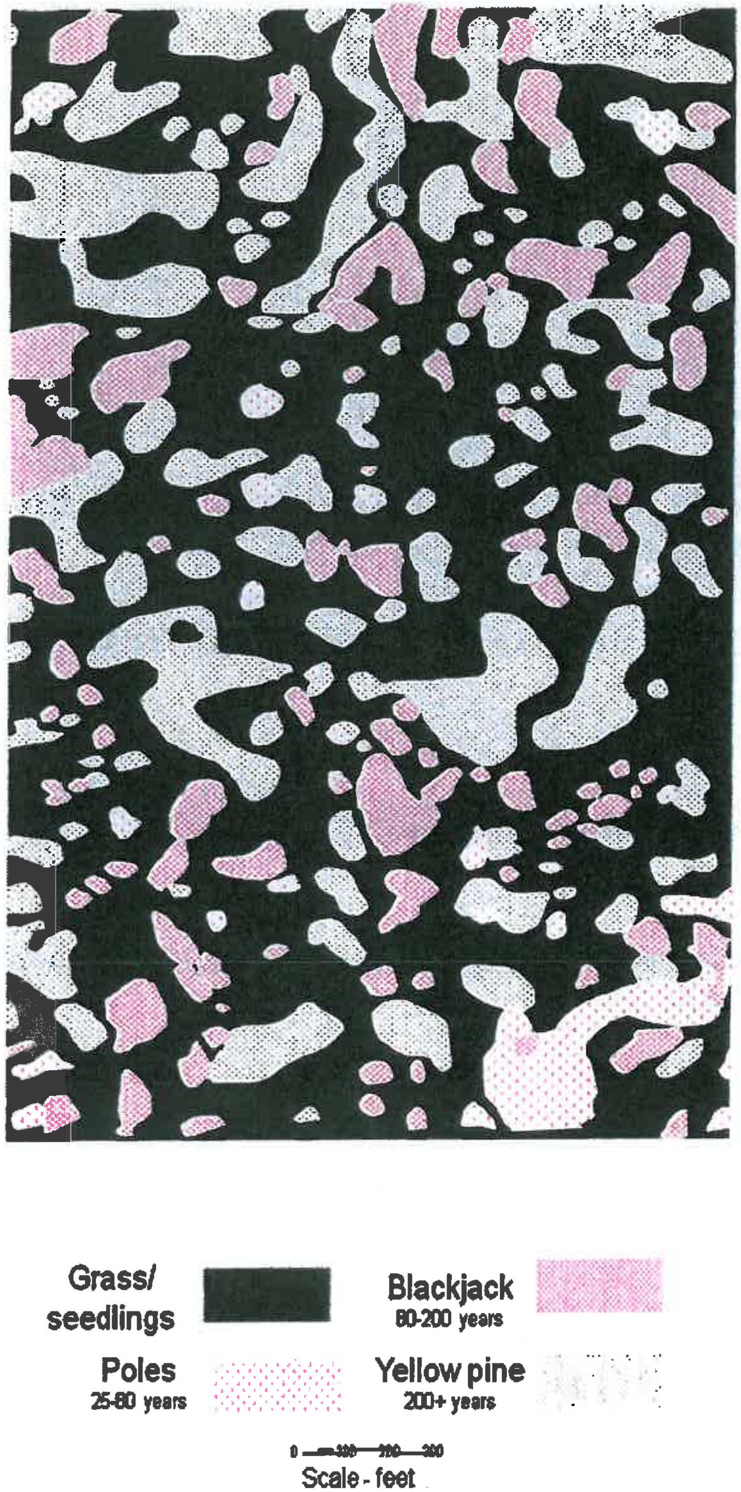

Figure 1: Gus Pearson Natural Area: Historic condition.

Mosaic of tree ages across the landscape with a well developed grass forb/shrub component and variable tree group sizes and spacing. All tree ages present. (ponderosa pine)

Photos 3 and 4: Interlocking or nearly interlocking crowns in groups of mid-age to old trees (ponderosa pine)

Dry (Frequent Fire) Mixed Conifer Forest

Desired Conditions

General Description

The dry mixed conifer forest vegetation community is transitional with increasing elevation between ponderosa pine and wet mixed-conifer forests and generally occurs at elevations ranging from approximately 5,500 to 9,500 feet. Dry mixed-conifer forests are dominated by mainly shade intolerant trees such as ponderosa pine, southwestern white pine, limber pine, quaking aspen, and Gambel oak, with a lesser presence of shade tolerant species such as white fir and blue spruce. Mid-tolerant species such as Douglas-fir are common. Aspen may occur as individual trees or small groups. This forest vegetation community typically occurs with an understory of grasses, forbs, and shrubs.

Landscape Scale Desired Conditions (an assemblage of mid-scale units)

At the landscape scale, the dry mixed conifer vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. Old growth is well-distributed in the landscape and occurs as groups of old trees mixed with groups of younger trees, or occasionally as larger groups comprised of mostly old trees. The forest contains various stages of development (even temporary openings or groups of very young trees) to provide future old growth groups within the landscape. Forest appearance is variable but generally uneven-aged and open; occasional patches of even-aged structure are present. The forest arrangement is in small clumps and groups of trees interspersed within variably-sized openings of grass/forb/shrub vegetation associations similar to historic patterns. Openings typically range from 10 percent in more productive sites to 50 percent in the less productive sites. Size, shape, number of trees per group, and number of groups per area are variable across the landscape. Where they naturally occur, groups of aspen and all structural stages of oak are present. Denser tree conditions exist in some locations such as north facing slopes and canyon bottoms.

The dry mixed conifer forest vegetation community is composed predominantly of vigorous trees, but declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris (>3 inch diameter), all well-distributed throughout the landscape. Snags are typically 18 inches or greater at DBH and average 3 per acre. Downed logs (>12 inch diameter at mid-point, >8 feet long) average 3 per acre within the forested area of the landscape. Coarse woody debris, including downed logs, ranges from 5 to 15 tons per acre.

The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, severity of disturbances, and to climate variability. The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, fire, and wind), including snags, downed logs, and old trees. Grasses, forbs, shrubs, needle cast (fine fuels), and small trees maintain the natural fire regime. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Frequent, low severity fires (Fire Regime I) are characteristic, including throughout goshawk home ranges. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

Mid-Scale Desired Conditions (an assemblage of fine scale units)

At the mid-scale the dry mixed conifer forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The more biologically productive sites contain more trees per group and more groups per area. Openings typically range from 10 percent in more productive sites to 50 percent in the less productive sites. Tree density within forested areas generally ranges from 30 to 100 square foot basal area per acre.

The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages. Occasionally small patches (generally less than 50 acres) of even-aged forest structure are present. Disturbances sustain the overall age and structural distribution.

Fires burn primarily on the forest floor and do not spread between tree groups as crown fire.

Forest structure in the wildland urban interface (WUI)[2] has smaller and more widely spaced groups of trees than in the non-WUI areas.

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[2] Note –each Forest needs to provide the definition for WUI that they are using.

Forest conditions in goshawk post-fledging family areas (PFAs) are similar to general forest conditions except these forests contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in goshawk foraging areas and in the general forest. Goshawk nest areas have forest conditions that are multi-aged but are dominated by large trees with relatively denser canopies than other areas in the dry mixed conifer type.

Fine Scale Desired Conditions (up to 10 acres)

Trees typically occur in irregularly shaped groups and are variably-spaced with some tight clumps. Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking. Openings surrounding tree groups are variably-shaped and comprised of a grass/forb/shrub mix. Some openings contain individual trees or snags. Trees within groups are of similar or variable ages and one or more species. Size of tree groups typically is less than 1 acre. Groups at the mid-age to old stages consist of 2 to approximately 50 trees per group.

Desired Conditions Glossary

Age class is defined as trees that originated within a relatively distinct range of years. Typically the range of years is considered to fall within 20 percent of the average natural maturity (e.g. if 100 years is required to reach maturity, then there would be five 20-year age classes).

Basal area is the cross-sectional area at breast height (4.5 ft above the ground) of trees measured in square feet. Basal area is a way to measure how much of a site is occupied by trees. The cross-sectional area is determined by calculating the tree's radius from its diameter (diameter/2 = radius) and using the formula for the area of a circle (π x radius^2 = cross-sectional area). Basal area per acre is the summation of the cross-sectional area of all trees in an acre or in a smaller plot used to estimate basal area per acre. Diameter at root collar (defined below) is used to calculate the cross-sectional area of multi-stemmed trees such as juniper and oak.

Clump refers to a tight cluster of two or more trees of similar size originating from a common rooting ball. Trees within a clump typically lean away from each other when mature. A clump of trees can exist within a group of trees, but a stand-alone clump of trees can function as a tree group.

Coarse woody debris is woody material on the ground greater than three inches in diameter, including logs.

Declining refers to the senescent (aging) period in the lifespan of plants that includes the presence of dead and/or dying limbs, snag-tops, and other characteristics that indicate the later life-stages of vegetation.

Diameter at breast height (DBH) is the diameter of a tree typically measured at 4.5 feet above ground level.

Even-aged forests are forests that are comprised of one or two distinct age classes of trees.

Uneven-aged forests are forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups.

Fire regime refers to the patterns of fire that occur over a long period of time across an appropriately scaled area (outlined in Table 1 below) and its immediate effects on the ecosystem in which it occurs. There are five fire regimes which are classified based on frequency (average number of years between fires) and severity (amount of replacement on the dominant overstory vegetation) of the fire. These five regimes are:

Fire regime I – 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (< 75% of dominant overstory vegetation replaced);

Fire regime II – 0 to 35 year frequency and high severity (> 75% of dominant overstory vegetation replaced);

Fire regime III – 35 to 100+ year frequency and mixed severity;

Fire regime IV – 35 to 100+ year frequency and high severity;

Fire regime V – 200+ year frequency and high severity

Table 1. Recommended scale of fires (in acres) by Fire Regime.

	Terrain	
Natural Fire Regime Group	**flat to rolling**	**steep and dissected**
I – 0 to 35 years, low/mixed	500 - 5,000	500 – 2,500
II – 0 to 35 years, replacement	500 – 10,000	500 – 5,000
III – 35 to 200 years, low/mixed	1,000 – 20,000	1,000 – 10,000
IV -35 to 200 tears, replacement	20,000 – 500,000	20,000 – 250,000
V – 200 + years, replacement	300,000 – 500,000	200,000 – 300,000
V – 200 + years, any severity	1,000 – 20,000	1,000 – 10,000

From: Interagency Fire Regime Condition Class (FRCC) Guidebook, Version 1.3.0, June 2008

Food web is a set of interconnected food chains within an ecological community linked together to display a full model of all possible feeding relationships of organisms within an ecosystem.

Foraging areas are the areas that surround the PFAs that goshawks use to hunt for prey. They are approximately 5,400 acres in size.

Group refers to an aggregation of two or more trees, typically with interlocking or nearly interlocking crowns at maturity, distinguished from other groups or trees. Groups are often delineated by openings. Size of tree groups is variable depending on forest type and site conditions and can range from fractions of an acre (a two-tree group) (i.e. ponderosa pine, dry mixed conifer) to many acres (i.e. wet mixed conifer, spruce fir). Trees within groups are typically non-uniformly spaced, some of which may be tightly clumped.

Invasive species are species that are not native to the ecosystem being described. For all ecosystems, the desired condition is that invasive species are rarely present, or are present at levels that do not negatively influence ecosystem function.

Nest areas are the areas immediately around a nest that are used by northern goshawks in relation to courtship and breeding activities. They are approximately 30 acres in size and contain multiple groups of large, old trees with interlocking crowns.

Old growth in Southwestern ponderosa pine and dry mixed conifer is different than a traditional definition based on Northwestern temperate conifer forests. Due to differences among Southwest forest types and their natural disturbances, old growth forests can vary in tree size, age classes, presence and abundance of structural elements, stability, and presence of understory (Helms 1998). In frequent fire forest types (e.g. ponderosa pine, dry mixed conifer) old growth in the desired conditions is defined as groups of old trees interspersed with groups of younger trees, but sometimes as patches of old trees. In infrequent fire forest types (spruce-fir, wet mixed conifer), old growth can occur in large patches. Old growth forests typically support communities of plants and animals that associate with or require large old trees. A single old tree is not old growth. Although old trees must be present, "old" is a relative term that varies among species. An *old-growth patch* is a group of trees having similar characteristics and conditions. Old-growth patches may include trees of similar ages and sizes or combinations of ages and sizes, and variable amounts of dead and downed material, dead and spike top trees, but such patches are readily distinguished from adjacent patches having less of these characteristics.

Openings (open areas) are treeless areas between single trees, groups of trees, or patches of trees that support grass, forb, shrub vegetation and on occasion, tree seedlings. Historically, many seedlings that established in openings between trees were killed by fire, a process that maintained the natural openness of frequent-fire forest types. Openings in this context are distinct from natural meadows, savannahs, and grasslands.

Patches are areas larger than tree groups in which the vegetation composition and structure are relatively homogeneous. Patches can range in size up to 1,000 acres.

Post-fledging Family Areas (PFAs) are the areas that surround the nest areas. They represent an area of concentrated use by the goshawk family until the time the young are no longer dependent on adults for food. PFAs are approximately 420 acres in size.

Resilience is used to infer the capacity of a system to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity, and feedbacks (Walker et al. 2004). Forest types are subject to different disturbance regimes that vary in severity, extent, and frequency, therefore the capacity for resilience is displayed through responses consistent with that disturbance regime.

Snags are standing dead or partially dead trees (snag-topped), often missing many or all limbs. They provide essential wildlife habitat for many species and are important for forest ecosystem function.

Tree (crown) cover is the area covered by the vertically projected tree crowns to the ground, for both single trees and grouped trees.

ATTACHMENT B

DESIRED CONDITIONS IN PONDEROSA PINE FORESTS: THE SUPPORTING SCIENCE

This document summarizes the scientific literature supporting the key compositional and structural aspects of the Desired Conditions in southwestern ponderosa pine forests. It outlines the work completed to date on a manuscript describing the development and science basis for the Desired Conditions. This summary focuses on the ponderosa pine forest type because (1) it is the most common non-woodland forest type in the Southwest, (2) it has been and is the focus of most vegetation management activities in the Southwest, and (3) it is the primary focus of the October 2011 Desired Conditions Workshop. There is a large body of literature on the ecology and natural range of variability of ponderosa pine forests. The key elements and functions of the Desired Conditions of a forest type are:

- species composition, overstory and understory,
- its characteristic tree density, spatial distribution, age composition,
- forest openings and the grass/forb/shrub vegetation matrix,
- habitats, biodiversity, and food webs,
- sustainability and resilience,
- fire frequency, behavior, and effects,
- hydrologic processes,
- visual attributes.

The Desired Conditions for ponderosa pine forests incorporated information on the ecology of the overstory and understory vegetation comprising this type as well as information on its historic or natural range of variability in the composition and structure of vegetation. The natural range of variation comes from 19th century descriptions of forest conditions by early explorers (Beale 1858, Wheeler 1875, Dutton 1882, Leopold 1924) and early scientists (Lieberg et al. 1904, Plummer 1904, Woolsey 1911, Pearson 1950), from tree ring, dendrochronological, and restoration studies (Fritts and Swetnam 1989, Covington and Moore 1994, Swetnam and Baisan 1996, Covington et al. 1997), vegetation classifications (Daubenmire 1968), forest vegetation simulations (cites), natural area and old growth studies (White 1985), fire histories (Morgan et al. 2001), and wildland fuel management strategies (e.g., Haig et al. 1941, Pearson 1950, Fulé et al. 1997, Reinhardt and Crookston 2003, Graham et al. 2004).

All southwestern forests and woodlands are periodically affected by natural disturbances such as fire, insects, disease, wind, and herbivory. These disturbances have variable effects on forest vegetation depending on the type, frequency, intensity, and spatial scale of disturbances. The type, frequency, and intensity of disturbances varied historically among forest and woodland types. A forest or woodland's characteristic composition, structure, and landscape pattern, the result of vegetation establishment, growth, and succession, combined with the periodic resetting of these by characteristic natural disturbances, constitutes a forest or woodland's natural range of variability. The temporal and spatial variability in vegetation establishment, growth, and mortality, and the consequences of natural disturbances in a forest or woodland define the natural range of variability. Much of the range of variability stems from fine- to landscape scale heterogeneity in aspect, slope, elevation, and soils that can lead to topographically different growing conditions and disturbance regimes (Beaty and Taylor 2001, Fulé et al. 2003). The ability of a forest ecosystem to absorb and recover from disturbances without drastic alteration of its inherent function is central to the concept of natural range of variability.

In the southwestern United States, fire is a primary disturbance agent and fire regimes are central to understanding natural range of variability as it relates to the composition, structure, and pattern in various forest types (Fulé et al. 2003). A description of fire regimes and ecological characteristics by forest type is displayed in Table 1.

Ponderosa Pine Forest

Key Characteristic: Species Composition

The Desired Condition is a forest overstory dominated by ponderosa pine, mixed where possible with pinyon and juniper species, oaks, aspen, or Douglas-fir, and a species-diverse and productive grass/forb/shrub understory. The ponderosa pine forests considered here are exclusive of the ponderosa pine-oak forests types, whose desired conditions are treated separately.

In this type, ponderosa pine is the dominant seral and climax tree species, but depending on locale may mix with gamble oak, several juniper and pinyon species (DeVelice 1986), quaking aspen, Douglas-fir, or southwestern white pine. Composition of the grass/forb/shrub understory is typically diverse in ponderosa pine forests, especially when canopy openings are present (Moir 1966, Naumburg and Dewald 1999, Laughlin et al. 2006, Abella 2011). Presence of shrubs is variable depending on habitat type and locale (USDA 1997), but when present may consist of sagebrush (*Artemisia* spp.), currant (*Ribes* spp.), snowberry (*Symphoricarpus* sp.), mahogany (*Cercocarpus* sp.), rabbitbrush (*Chrysothamnus* spp.), saltbrush (*Atriplex* sp.), morman tea (*Ephedra* sp.), manzanita (*Arctostaphylos* spp.), ceonothus (*Ceonothus* spp.), bitterbrush (*Purshia* spp.), *Oregongrape* (Mahonia spp.), oak shrub (*Quercus* sp.), rose (*Rosa* spp.), and locust (Robina sp.). While grasses and herbs occur in most ponderosa pine types, the composition, abundance (cover), and productivity is variable depending on soil, aspect, elevation, latitude, moisture, and the presence or absence of tree cover (Moir 1966, Naumburg and Dewald 1999, Laughlin et al. 2006, Abella 2011). The more common grasses are sedge (*Carex* spp.), muhly (*Muhlenbergia* spp.), muttongrass (*Poa* sp.), junegrass (*Koeleria* sp.), bluestem (*Schizachyrium* sp.), ricegrass (*Piptochaetium* sp.), squirreltail (*Elymus* sp.), fescue (*Festuca* spp.), grama (*Boutuloua* spp.), needlegrass (*Stipa* spp.), pine dropseed (*Blepharoneuron* sp.), threeawn (*Aristida* sp.), bluestem (*Andropogon* spp.), brome (*Bromus* spp.), and wheatgrass (*Pascopyrum* spp.) (UDSA 1997). More common forbs are sagewort (*Artemisia* sp.), geramium (*Geranium* spp.), goldenrod (*Solidago* spp.), cinquefoil (*Potentilla* spp.), pussytoes (*Antennaria* sp.), fleabane (*Erigeron* sp.), groundsel (*Senecio* spp.), brackenfern (Pteridium sp.), vetch (Astragalus spp., Vicia sp.), peavine (Lathyrus sp.), goldenaster (*Heterothecs* spp.), meadowrue (*Thalictrum* sp.), buckwheat (*Eriogonum* spp.), and gromwell (*Lithospermum* sp.) (USDA 1997).

Key Characteristic: Tree density and distribution

The vegetation structure in ponderosa pine forests throughout the Southwest has changed considerably from the natural or historical condition. Tree harvests and livestock grazing, coupled with a reduction in fire frequency and intensive fire suppression since Euro-American settlement have resulted in significant increases in tree densities, mostly in the smaller diameter classes, increased densities of shade-tolerant, less fire resistant tree species (e.g.,Douglas-fir, white fir, juniper), and increased fuel loads (Parsons and Debenedetti 1979, Moore et al. 2004, Naficy et al. 2010, Scholl and Taylor 2010). For example, a 1990s re-measurement of tree densities on 15 partially-harvested 2.5-acre plots in ponderosa pine in Arizona and New Mexico, originally measured by T. S. Woolsey and G. A. Pearson in 1909-1913, showed that mean trees per acre increased over nine decades by a factor of almost 7; from

77 to 519 trees per plot (Moore et al. 2004). In many areas, tree species compositions have shifted towards more shade tolerant and less fire resistant species. Increased tree densities and tree encroachment into openings and meadows has resulted in increased shading and a decline in percent cover, abundance, and diversity of understory grasses, forbs, and shubs (Covington and Moore 1994, Bogan et al. 1998, Swetnam et al. 1999, Abella 2009). Increased tree densities also altered hydrologic cycles by lowering total stream flows, peak flows, and base flows (Ffolliott et al. 1989, see Troendle and King 1985 for effects of tree removal on hydrologic cycles). Increased tree densities and invasion of ponderosa pine and dry mixed conifer forests by less fire-tolerant tree species has resulted in increased number, size, and severity of wildfires (Allen 2007).

Historical tree densities on reconstructed plots throughout the Southwest varied depending on factors such as elevation, aspect, slope, soils, moisture, and a site's unique history. An example of this was a reconstruction study involving 53 2.5-acre plots representing nine different ponderosa pine ecosystem types near Flagstaff, Arizona. Historical tree densities on these sites varied 19-fold, and averaged between 2 -40 trees per acre (Abella and Denton 2009). Moore's et al. (2004) reconstruction study on their 15 2.5 acre Woolsey plots (discussed above) estimated (based on live tree and cut-stump BA) a mean density of 40 trees per acre (Moore et al. 2004). On the same Woolsey plots, Sánchez-Meador et al. (2010) found that the number of tree groups ranged from 4-11 per acre and ranged in size from 0.004 ac to 0.06 acre. Other reports of historical tree densities include 22 trees per acre near Walnut Canyon (Menzel and Covington 1970), 23 trees per acre at Bar-M-Canyon (Covington and Moore 1994), 24 trees per acre on the Gus Pearson Natural Area (GPNA) on the Fort Valley Experimental Forest (Mast et al. 1999), and 24 trees per acre at Camp Navajo (Fulé et al. 1997). A 1938 forest inventory on the Long Valley Experimental Forest (central Arizona) showed that 75 trees per acre were present prior to the cessation of frequent fire (between 1880 and 1900). Woolsey (1911) reported an average of 18 trees per acre (> 4 inches dbh) in northern Arizona in the early 20th century.

Structural characteristics widely reported for historical Southwest ponderosa pine are relatively open forests with trees typically aggregated in small groups within a grass/forb/shrub matrix (Cooper 1960, White 1985, Pearson 1950, Covington et al. 1997, Abella and Denton 2009). Recent work in northern Arizona has shown that tree densities across nine different ponderosa pine ecosystems depended to a large extent on soil type and climatic variables (minimum spring and fall temperatures, May precipitation) (Abella and Denton 2009). This work also showed that the degree to which trees were aggregated into groups was largely explained by ecosystem soil type. Twenty-eight to 74 percent of all trees were in groups; the remaining trees were scattered individual trees (Abella and Denton 2009). These structural conditions were maintained by frequent low-intensity surface fires that more often killed small rather than large trees (Dieterich 1980, Weaver 1951, Fiedler et al. 1996; but see Leirfallon and Keane 2011). Other small-scale disturbances such as insects, disease and others also shaped this characteristic forest structure. Low intensity fires occurred every 2 to 12 years and maintained an open canopy structure (Covington et al. 1997, Moir et al. 1997). Typical historical tree groups ranged from 0.1 to 0.75 acres in size and comprised 2 to 40+ trees per group (White 1985, Fulé et al. 1993, Covington et al. 1997). The grass/forb/shrub understory and fine fuels (needles, cones, limbs) from large trees fueled these frequent fires started by lightning and, to an uncertain extent by Native Americans (Kaye and Swetnam 1999, Allen 2002). Regular fire thinned or eliminated thickets of small trees, resulting in open, park-like forests (Cooper 1960, Covington et al. 1997, Allen et al. 2002). Restoration studies on the Fort Valley Experimental Forest near Flagstaff, Arizona, showed an average of 23 trees per acre that were grouped into distinct 0.05- to 0.7-acre groups consisting of 2-40 trees (Covington et al. 1997). In the White Mountains of Arizona, the average size of tree groups in ponderosa pine was 1/5th of an acre (Cooper 1961).

Key characteristic: Forest openings and grass/forb/shrub matrix

A key characteristic of the Desired Conditions for ponderosa pine are canopy openings that comprise between 30 and 70 percent (extremes =10 to 80%) of a landscape. These openings lack tree crown cover and support a desired grass/forb/shrub community. Woolsey (1911) described late 19th century southwestern ponderosa pine forests as having "*...pure park-like stand(s) made up of scattered groups of from 2 to 20 trees, usually connected by scattering individual. Openings are frequent and vary in size. Because of the open character of the stand and the fire-resisting bark, often 3 inches thick, the actual loss in yellow (ponderosa) pine by fire is less than with other more gregarious species.*" Others also described historical ponderosa pine forests as having low tree density, open, savanna-like stands consisting of groups of pine trees interspersed with grassy or shrubby openings (White 1985). Grass openings in southwestern ponderosa pine account for the highest level of plant diversity (Laughlin et al. 2006) and spatial patterns influence genetic diversity (DeWald 2003), growth of trees (Biondi 1996, Ffolliott et al. 2000), forest dynamics (Youngblood et al 2004, Boyden et al. 2005, Sánchez-Meador et al. 2009), wildlife habitat (Reynolds et al. 1992, Waltz and Covington 2003, Dodd et al. 2006, Wightman and Germaine 2006), and risk of stand-replacing crown fires (Fulé et al. 2007). Unfortunately, the actual degree of "openness" has received little measurement; instead, most reconstruction/restoration studies focused on tree densities and tree aggregation. Although White (1985) did not define how close trees had to be to constitute a "group" (he appeared to use the absence of 1919 regeneration beneath large tree crowns to define groups, which consisted of ≥3 trees), he reported 22 percent of his plot on the GPNA was under tree groups. Thus, 78 percent of the 18 acre area would likely have been open before the 1919 regeneration pulse (White 1985). White (1985) reported that 12 percent of the historical trees on his plot were not in groups of three trees; if he had included single trees and groups of 2 trees, the percent open would have been less than 78 percent. Covington et al. (1997), also working on the GPNA, reported that while canopy cover was high within groups of trees, only 19 percent of the surface area of their Fort Valley study plot was under pine canopy; the balance (81%) represented grassy openings (Covington et al. 1997). Gill's et al. (2000) estimate of mean crown radius of mature ponderosa pine of 19.7 feet to estimate the range of total per-acre area under projected crowns, on the 53 study plots of Abella and Denton (2009), plots with two trees had less than 2 percent under crowns (98% open) and the 40-tree plot had 28 percent under crowns (72% open). The same approach for the 75 trees present before the cession of fire (about 1900) on the Long Valley Experiment Forest resulted in about 52 percent of the per acre area under tree crowns (48% open).

Trees in ponderosa pine forests affect soil properties, and species richness, cover, and the distribution of grass/forb/shrub species. For example, trees affect soil moisture, nutrients, and other ecosystem components such as microclimates above and below the soil surface (Arnold 1950, Barth 1980, Moir 1966, Parker and Muller 1982, Covington et al. 1997, Scholes and Archer 1997, Abella 2009). These components and microclimates can affects many plant and animal species and ecological processes, including biodiversity, trophic interactions, food webs, wildlife, and hydrology. Environmental parameters such as light intensity, pH, litter depth, soil depth, percentage of exposed rock, and percentage of litter cover are directly influenced by the presence or absence of canopy cover (Evensen et al. 1960). In northern Arizona ponderosa pine-Gamble oak forests, openings had greater species richness, three to eight times greater plant cover than under tree canopies, and there were no species more abundant under ponderosa pine trees (Abella 2009). In addition to the importance of openings, Abella's (2009) work pointed to the importance of Gamble oak in pine forests. Single oaks had the high species richness beneath them while oak clumps and thickets provided unique habitat for several forb species. Clearly, canopy openings need to be re-established and maintained in ponderosa pine forests if grass/forb/shrub communities are to be diverse, productive, and support plant, invertebrate, and vertebrate species that depend on these communities (Kruse et al. 1992, Rosenstock 1998, Ganey et al. 1992, Reynolds et al. 1992, 2006, Abella 2009).

Key Characteristic: Snags, logs, woody debris

To be completed

Key Characteristic: Habitats, biodiversity, food webs

Many ecosystem processes influence plant productivity, soil fertility, water availability and quality, atmospheric chemistry, and other local and global environmental conditions. These ecosystem processes are controlled by both the diversity and identity of plant, animal, and microbial species native to an ecosystem. Recent studies suggest that reductions in biodiversity can alter both the magnitude and stability of ecosystem processes (Naem et al. 1999). As the dominant tree species, ponderosa pine influences the entire forest ecosystem, affecting understory vegetation, soils, and plant and animal habitats and communities (Moore et al. 1999). Southwestern ponderosa pine forests are habitat for over 250 species of vertebrates, many species of plants, invertebrates, and soil organisms (Patton and Severson 1989, Allen 2002). Native plants and animals are adapted to naturally high levels of heterogeneity in ponderosa pine ecosystems, and some species are dependent on diverse habitats for their survival (Reynolds et al. 1992, 2006; Dodd et al. 1998). Current conditions are atypically homogeneous in composition and structure with reduced plant and animal habitats and lowered biodiversity. Moving the current forest conditions to the Desired Conditions can affect many of these plants and animals in various ways (Reynolds et al. 1992, Rieman and Clayton 1997, Oliver et al. 1998, Reynolds et al. 2006, Abella 2009). Achieving the Desired Conditions restores habitats at the fine-, mid-, and landscape scales, particularly by increasing diversity and productivity in grass/forb/shrub layers. Nonetheless, there may be a potential for the Desired Conditions to lower the viability of sensitive and threatened species through habitat alteration and fragmentation (U.S. Fish and Wildlife Service 1998, 2011, Holthausen et al. 1999). For some of these species, concerns might be ameliorated by developing site-specific desired conditions for breeding sites, feeding sites, or entire refugia (for changed desired forest conditions with increasing distance from nest sites see Reynolds et al. 1992). Also, it is worth noting that breeding sites or entire refugia for species of special concern could be protected from catastrophic loss by surrounding them with the Desired Conditions, thereby lowering the risk of complete loss due to forest-killing crown fires. The ponderosa pine Desired Conditions are comprised of diverse landscapes with groups and patches of variable tree densities, including groups with dense, closed canopies (interlocking crowns); densely shaded soils beneath tree groups; tree ages young to old; species-rich and productive grass/forb/shrub communities; dead, deformed, and diseased trees; large logs, and woody debris; and old large oaks, aspen, and other important trees. Each of these is a critical component of the habitat of many native species (Reynolds et al. 1992, Rosenstock 1998, Bennetts et al. 1996, Bull et al. 1997, Dodd et al. 1998).

The habitat diversity components of the ponderosa pine Desired Conditions as described above can lead to more robust food webs. The importance of forest habitat diversity and robust food webs is illustrated in efforts to conserve northern goshawk populations in the Southwest (Reynolds et al. 1992, 2006). In the American Southwest, goshawk reproduction output varies extensively year to year and is strongly associated with the abundance and availability of food; in years when prey numbers are low, goshawk population reproduction can be a small fraction of reproduction in years when prey is abundant (Reynolds et al. 2005, Reynolds et al. 2006, Salafsky et al. 2005a, 2007b). Goshawks are prey generalists that feed on a broad suite of prey; from robins, jays, woodpeckers, doves, and grouse to tree squirrels, ground squirrels, rabbits, and hares (Reynolds and Meslow 1982, Squires and Reynolds 1997). Each goshawk prey species occupies a different habitat; tree squirrels, woodpeckers, and jays primarily occupy tree habitats while ground squirrels, rabbits, and hares occupy open grass/forb/shrub habitats, and still others (robins, grouse, doves) use both habitats (reviewed in Reynolds et al. 1992). Annual population highs and lows of each prey species are not always in phase, a years' population low in one or more prey is often compensated by higher numbers in other species (Salafsky et al. 2006). Over a period of years it becomes clear that because of this compensation, the entire suite of prey -- not any single prey species -- is important to goshawk reproduction. A forest management strategy that maximizes the habitats for one or a few prey species is not likely to sustain a goshawk population. Rather, a strategy that provides habitats of the wide variety of plants and animals in the hawk's food web is more likely to succeed (Reynolds et al. 1992). The Desired Conditions in ponderosa pine provide a wide variety of habitats; densely canopied tree groups with interlocking crowns and limby boles on the outside, a matrix of grass/forb/shrub vegetation, and old forest structural elements (large snags, logs, and woody debris). Each of these habitats is critically important for one or more of the goshawk prey species.

Key Characteristic: Sustainability and Resilience

The compositional and structural changes have resulted in increased vulnerability of current southwestern ponderosa pine forests to uncharacteristically high disturbance intensities and extents, particularly from fire and insects (Covington 1993, Moore et al. 1999, Allen 2007, North et al. 2009, Collins et al. 2011). Greatly increased tree densities due to fire exclusion have negatively affected forest health by accelerating old tree mortality, facilitating insect outbreaks, diminishing productivity of understory plants, altering food webs, and increasing fire severity (Covington and Moore 1994, Abella and Denton 2009). Current conditions are therefore not natural or sustainable (Swetnam et al. 1999). Current conditions in ponderosa pine are conducive to insect epidemics and stand-replacing wildfires, which can convert forests to shrublands (Savage and Mast 2005). This highlights the importance of understanding natural (or reference) conditions when developing Desired Conditions for forest restoration. Woolsey (1911) described how fire functions to maintain natural range of forest structure, ..."*A crown fire in mature timber is almost unheard of, and in a ground fire in the virgin forest young saplings often escape complete destruction, though with a fair wind and on a steep slope destruction of seedlings and saplings is often complete...In June 1910, a fire occurred on the Gila, Datil and Apache National Forests which burned over about 60 square miles. The area burned was steep and rocky, with an unusual quantity of dry forage. An investigation showed that injury to the yellow (ponderosa) pine was confined very largely to the reproduction. On the area as a whole, from 40 to 50 percent of the seedlings were killed.*"

Sustaining the Desired Condition mix of plant and animal habitats over space and time requires the incorporation of the spatial and temporal dynamics of forest vegetation. Vegetation dynamics, including the establishment, development, senescence, and its composition, structure, and pattern, can be estimated and modeled (see Oliver and Larson 1990, Reynolds et al. 1992, Franklin et al. 2002, Reinhardt and Crookston 2003). An example of the incorporation of dynamics in sustaining the maximum amount of mature and old trees in southwestern forests was best achieved with about 20% in seedlings/saplings), 20 % in young forest, 20 % in mid-aged forest, 20 % in mature forest, and 20 % in old forest (Reynolds et al. 1992). These proportions reflect forest development from cohort establishment (seedling/saplings) to old forest structure (Figure 1). Based on forest type, these structural stages are distributed at the fine scale for ponderosa pine, dry mixed conifer, and some pinyon-juniper types, at the mid-scale for wet mixed conifer, some spruce-fir, and pinyon-juniper types, and at the landscape-scale for most spruce-fir types.

The Desired Conditions have a range of metrics (trees/ac, BA, degree of tree aggregation and openness) that match a site's capability so that the conditions can be attained and sustained. Knowledge of the historical forest composition and structure on a site can provide estimates of tree species and densities that were sustainable through at least several generations of trees (Allen et al. 2002, Abella et al. 2011). It may not be necessary, or even desirable in some cases, to have desired conditions that are within the natural range of variability at every site in southwestern forests and woodlands. However, historical conditions are more synchronous with the natural disturbance regime to which the forest and woodland ecosystems are adapted. Social, political and economic factors are much different today than a century ago and there are valid considerations for leaving areas of higher or lower tree-density or differing composition to meet resource management needs. But restoration on some portion of the landscape to conditions reminiscent of pre-European settlement times would most likely provide for greater biodiversity, and greater ecosystem productivity, stability, sustainability, and services.

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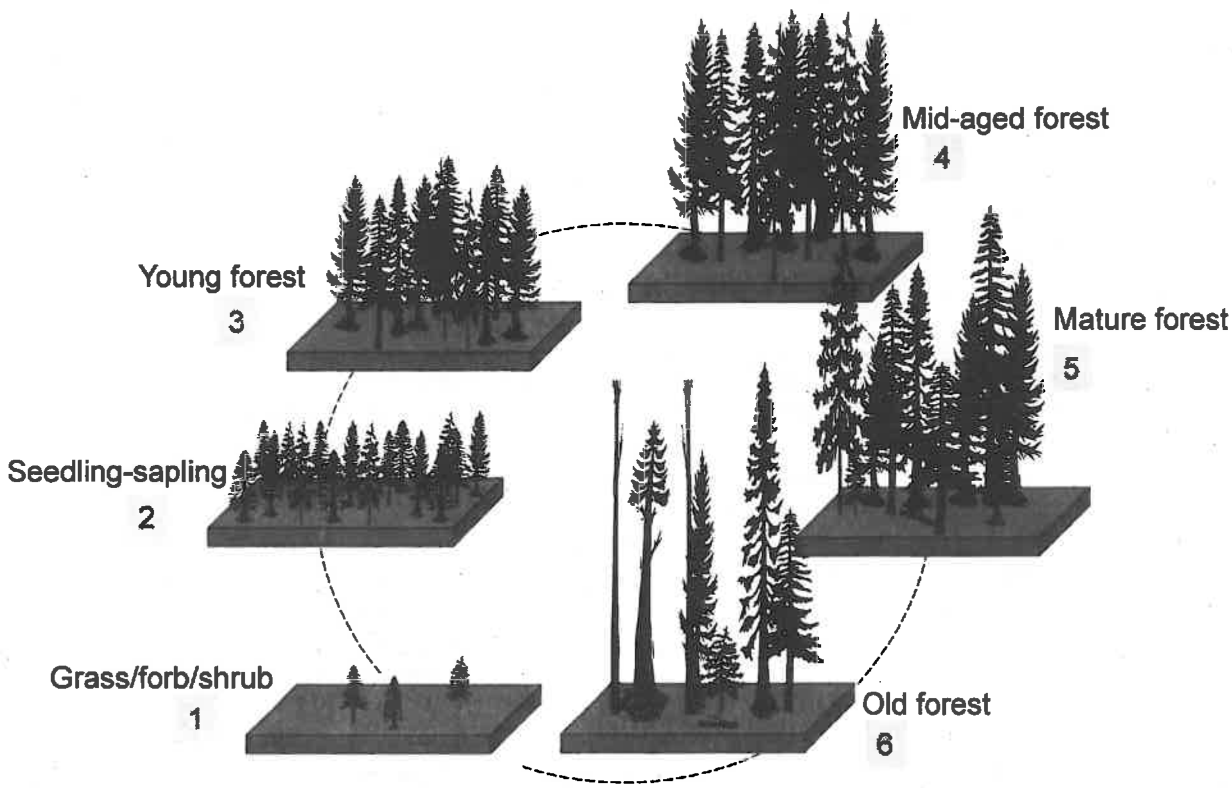
Table 1. Southwestern forest types and dominant characteristic natural disturbance regimes.

Forest Type	Fire Regime [1, 2]	Fire Type [2]	Forest Structure	Seral Species	Climax Species
Ponderosa pine (and sub-types)	frequent/ low severity 2-17 yrs. (regime I)	surface	uneven-aged, grouped, open	ponderosa pine	ponderosa pine
Dry Mixed conifer/ frequent fire (warmer/drier)	relatively frequent/ low-mod severity 9-22 yrs. (regime I)	surface (common) mixed (rare)	uneven-aged, grouped, open uneven-aged, patched, open	dominant -ponderosa pine subdominant - aspen and/or oak (sub-stand scale patches)	fire dis-climax historic condition- shade intolerant species: dominant – ponderosa pine; subdominant - Douglas-fir, Southwestern white pine or limber pine
Wet Mixed Conifer/ infrequent fire (cooler/wetter)	relatively infrequent/ mod-high severity variable, 22-150 yrs. (regime III, IV)	mixed (common) stand-replacing (rare)	uneven-aged, patched, closed even-aged, closed	dominant – aspen or Douglas-fir, depending upon plant association habitat type	shade tolerant species, depending upon plant association habitat type: white fir, blue spruce
Spruce-fir (mixed, lower sub-alpine)	infrequent/ mod-high severity 150-400 yrs. (regime III, IV)	mixed/stand-replacing	even-aged, closed	dominant – aspen or Douglas-fir, depending upon plant association habitat type	shade tolerant species, depending upon plant association habitat type: Engelmann spruce, white fir
Spruce-fir (upper sub-alpine)	infrequent/ high severity 150-400 yrs. (regime IV, V)	stand-replacing	even-aged, closed	dominant – aspen, Douglas-fir or Engelmann spruce, depending upon plant association habitat type	shade tolerant species: Engelmann spruce and corkbark or sub-alpine fir co-dominate

[1] Schussman et al. 2006.
[2] Historical Range of Variation and State and Transition Modeling of Historic and Current Landscape Conditions for Potential Natural Vegetation Types of the Southwest. The Nature Conservancy: Southwest Forest Assessment Project. 2006.

Figure 1. Growth of tree groups.



Restoration of Western Frequent Fire Forests: An Evolutionary Perspective of Desired Conditions

Wally Covington
School of Forestry
and
The Ecological Restoration Institute
Northern Arizona University

Overview

- Where are we?
- Where have we been
- How did we get here?
- Where are we going?
- What should we do?

The greater ecosystem of the West are in widespread decline

- Greater ecosystems are regional complexes of ecosystems
- Generally 1-10 million acres in size
- Have common landscape-level characteristics
- Linked by: 1) wide ranging wildlife, 2) landscape scale disturbance regimes, and 3) human social and political systems.

What is ecological restoration?

- Based on evolutionary biology and ecosystem ecology
- Reference conditions are fundamental—natural patterns and processes are the starting poing
- Departures from reference conditions should be based on best available science
- Maintenance of restored landscapes involves a broad set of options from allowing for self-regulation to active management

Where are we?
The greater ecosystems of the West are exhibiting alarming disease symptoms

- Population irruptions and population crashes
- Spread of invasive exotic plants
- Decreasing diversity, increasing homogeneity at all levels of the ecosystem
- Unnatural disturbance regimes: fire, insects
- Trajectory of spiraling decline of ecological and social system health
- Declines are greatest in frequent fire forests

Evolutionary ecology of frequent fire forests

- Ponderosa pine, the archetypal frequent fire tree, exhibits morphological and physiological adaptations to frequent surface fire
- Shows up in fossil record 70 million ybp
- At 25 million ybp evidence from SW Colorado
- Communities of organisms have tracked favorable climatic regimes up and down in elevation and latitude over time
- Self-regulating processes have assured persistence in the face of climate change

"Our view of the past is compromised by our failure to recognize the uncharacteristic nature of the present."

Evolutionary biologist Stephen Jay Gould. 1991

Climate and CO2 fluctuations have been common throughout evolutionary time

- Frequent fire forest have been resilient to wide swings in temperature and CO2
- CO2 during the early Eocene (58-48 M ybp) was over 1100 ppm, compared to today's concentration of 387 ppm up by 80 ppm since 1940
- Sudden (within 100 yr) 4-6 degree C changes in temperature are common throughout the fossil record
- Frequent fire forests have been resilient to these changes under natural densities and self-regulatory mechanisms such functional redundancy and frequent fire.

What is coming at us?

" . . . we anticipate an acceleration of historical changes in the Inland West including increased fuel accumulations, lengthened fire seasons and intensified burning conditions, all contributing to larger and more catastrophic fires."

From "Historical and Anticipated Changes in Forest Ecosystems of the Inland West of the United States." Covington, Everett, Steele, et al. 1994

How did we get here?

Overgrazing
Predator "control"
Fire exclusion
Overcutting of old-growth trees
Failure to control density of young trees
Introduction of invasive exotic species
Unplanned, poorly engineered road systems
Inadequate social system futuring/adaptation

Crownfires are the latest in a long series of symptoms of declining ecosystem health

- Loss of herbaceous cover
- Increased erosion
- Tree population explosions
- Watershed degradation
- Loss of plant and animal diversity
- Loss of esthetic values
- Unnatural insect and disease epidemics
- Shift to catastrophic crownfires
- Destruction of human and wildlife habitats

The catastrophic fire seasons of 2000, 2002 and 2011 were predicted; the trend will continue

Environmental Impacts

- Costs of fire suppression
- Homes and infrastructure
- Wildlife and human habitats
- Air quality and carbon dioxide balance
- Watersheds and water quality and supply
- Recreation facilities
- Evacuation costs
- Tourism
- Timber
- Cultural and archaeological sites
- Rehabilitation and restoration costs
- Public health

Large landscape scale beetle and defoliator epidemics are here and becoming common.

"If we are serious about practicing land health then, we have to know what we the land was like to begin with."

Aldo Leopold 1947.

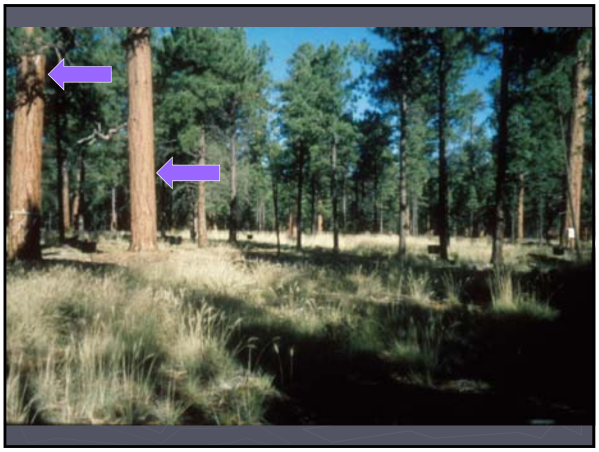
Reference conditions vary with soil type, elevation, and climatic regime

Broad similarities exist, but variations in pattern and processes do occur

- Fort Valley Experimental Forest AZ
- Pringle Falls Experimental Forest OR
- Black Hills National Forest SD

Reference Restoration Thinning Treatment

- Retain trees which predate settlement
- Retain postsettlement trees needed to re-establish presettlement structure
- Thin and remove excess trees
- Rake heavy fuels from base of trees
- Burn to emulate natural disturbance regime
- Seed with natives/control exotics

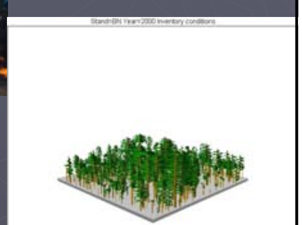


Change Basic Prescription for Specific Resource Objectives

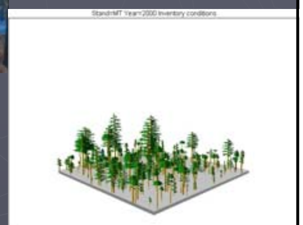
- Might leave more trees to accommodate specific resource management objectives, e.g., screening cover for human or wildlife habitat goals, future wood harvesting, favoring specific uses
- Might leave fewer trees to accommodate other objectives, e.g., to favor viewsheds, wildlife goals, grazing, water balance

Alternative Restoration Thinning Prescriptions Produce Very Different Outcomes for Fire Behavior and Resource Responses: There Appear to be Thresholds

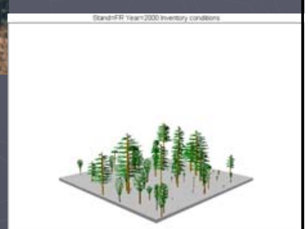
Burn Only



Minimal Thinning



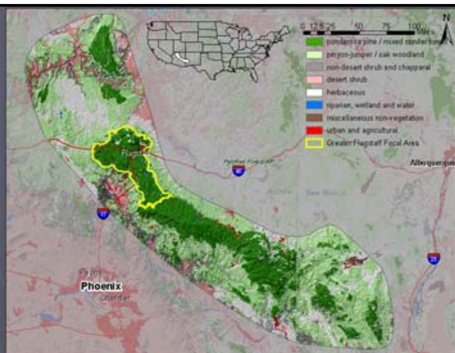
Full Restoration



Predicted Fire Characteristics
June 97th-percentile weather, 30 mph

	1876	1997	1.5:1	3:1
Tree/ac	47	383	70	141
Fire type	**surface**	**active**	**surface**	**passive**
% crown	0	100	20	69
btu/ft^2	491	2331	673	1790
herbage	856	112	571	134

Comprehensive ecosystem restoration approaches not only reduce crownfire threat, but also improve forest health and resource use opportunities for present and future generations.



We must think and act at a scale and pace appropriate to the forest health crisis.

What is the role of SWERI?

- Evidence-based decisions are fundamental
- Knowledge synthesis
- Knowledge discovery
- Knowledge translation
- Knowledge transfer
- Cooperative knowledge application
- Central is pursuit of relevant knowledge in direct support of ongoing implementation
- Neutral unbiased convener for collaboration

This is a big problem--but we can solve it

- Restoration based approaches are proven at a small scale (1000+ ac)
- They must be tested and refined as we apply them at large scales (1,000,000+ ac) in an adaptive management approach
- Multi-scaled collaborative adaptive approaches must be based on solid science
- Communities and local gov'ts. have major leadership roles to play in this effort

"Between the two extremes of blindly following nature on the one hand and open revolt against her on the other, lies a broad area for working in harmony with natural tendencies."

Forest ecologist Henry J. Lutz
1969.

Bluewater Forest Restoration Project – Desired Condition Demonstration, Cibola National Forest

Purpose of Visit:

- Discuss the concepts and various aspects of the desired conditions including: the degree of structural openness; the grass/forb/shrub matrix; the size (area, number of trees), shape, and spacing of tree groups; the interlocking crowns of trees within groups; the diversity and interspersion of tree structural (age, size) stages, and the sustainability of the desired conditions.
- Discuss and discuss the value of the desired conditions for wildlife habitat and food webs.
- Discuss how key elements of the desired conditions relate to natural disturbances.
- Discuss specific differing existing conditions that are moving towards the desired conditions.
- Discuss the ecological, social, and economic outcomes of achieving the desired conditions.

Background:

- Demonstration site (stand 5A) represents a ponderosa pine forest growing on moderately-productive (average) site. This site has had fire exclusion since the early 1900s, with the exception of slash burning following cutting 25+ years ago.
- Past management: this site was cut 25+ years ago to remove diseased, dying and poorly-formed trees (sanitation/salvage cutting). Pre-treatment (2010) stand condition: uneven-aged structure/high-density, modeled fire behavior - high-intensity crown fire.
- Prescribed cutting treatment (focused on the desired conditions and restoration) were implemented during summer 2010. Prescribed burning treatments are scheduled for fall/winter 2011/12.

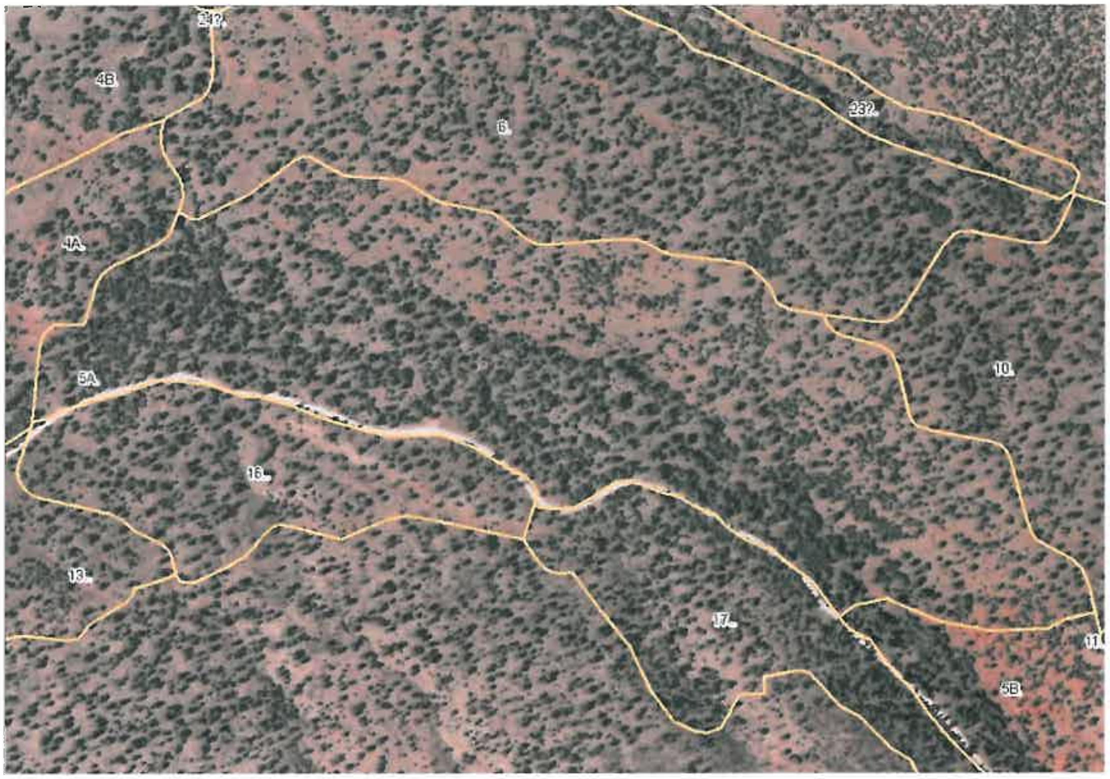
Demonstration Stand (post-treatment):

- Uneven-aged stand structure (3+ ages): within the stand, there are roughly balanced areas of young, mid, and old age trees with provision of suitable openings between tree groups for development of grass/forb/shrub component and localized recruitment of trees.
- Desired spatial patterns are <u>similar</u> to natural conditions
  - Tree groups with interlocking crowns
  - Fine–scale dispersion of tree groups
  - Grass/forb/shrub openings
- Small diameter woody debris abundance is higher than desired (pre-burning).
- Downed logs and snags are less than desired.
- Tree densities (within group and per unit area) are within desired ranges (overall avg. 40-80 sq. feet basal area).
- Seedlings have not yet established in desired locations.
- Desired grass/forb/shrub cover has not yet established.
- Modeled fire behavior is low-intensity surface fire.

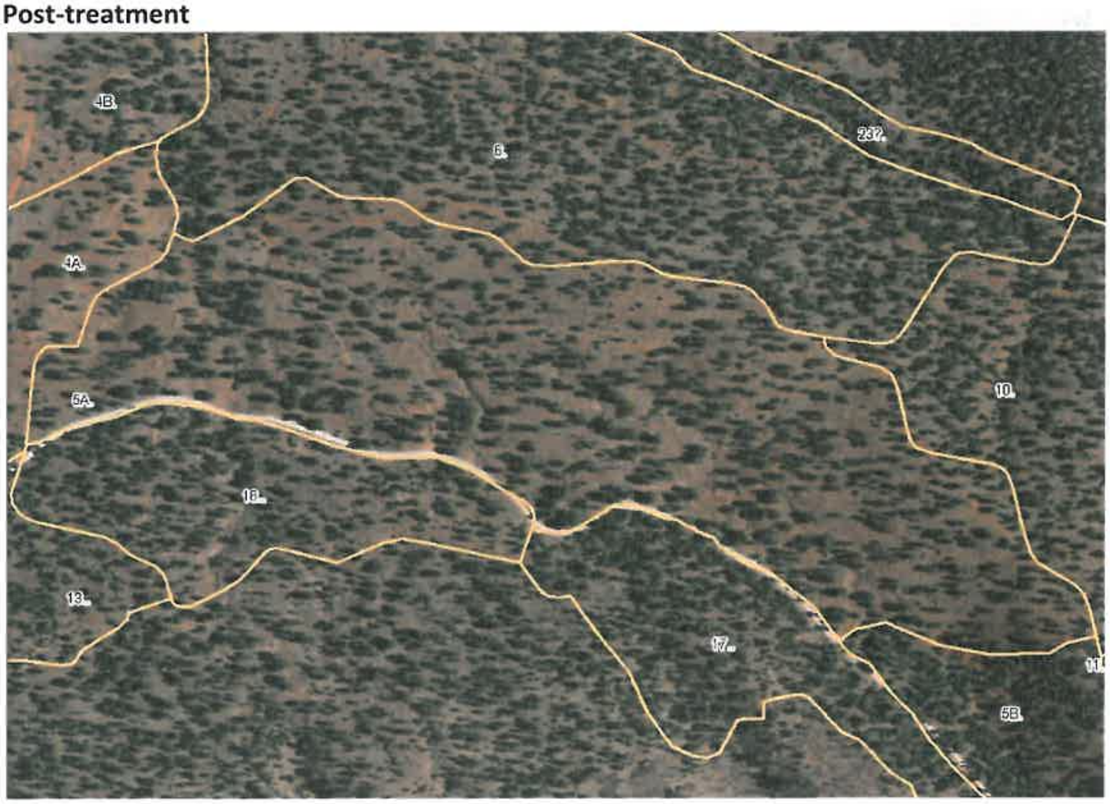
Bluewater Forest Restoration Project – Desired Condition Demonstration Data

1) <u>Aerial photos</u>

Pre-treatment



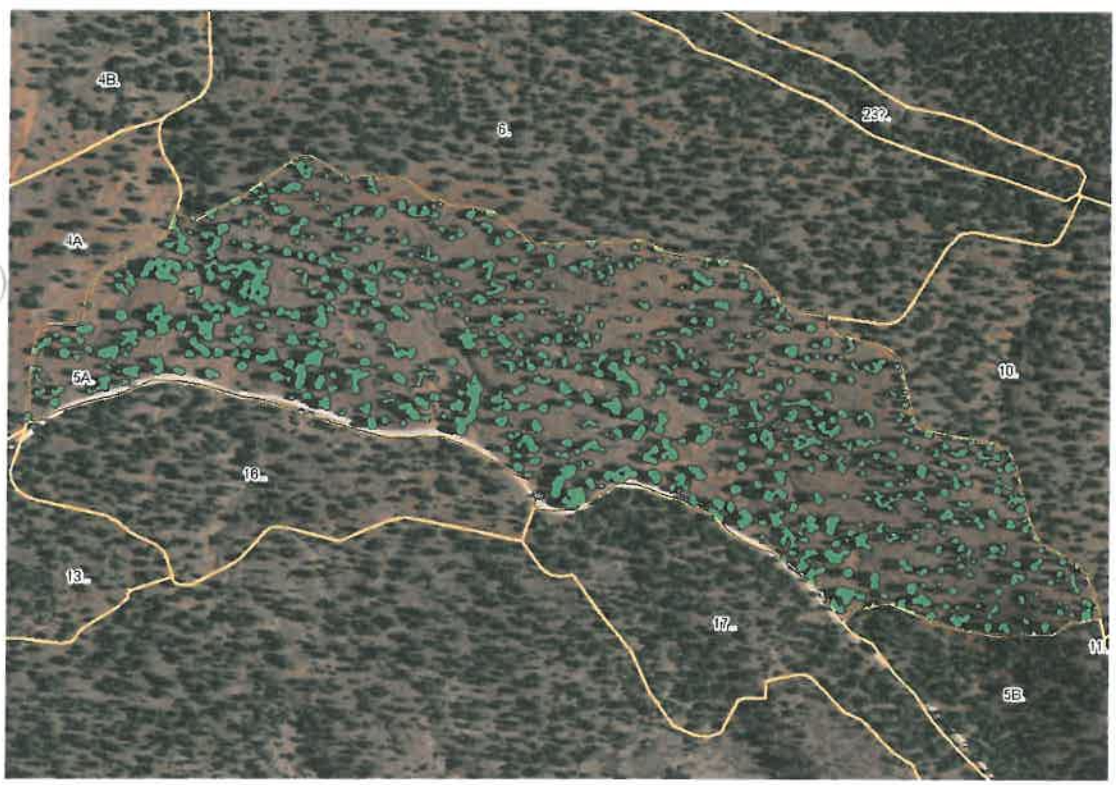
Post-treatment



2) Stand 5A exam data (post-treatment)

All Species Diameter Class	Trees/ Acre	Basal Area/ Acre
1 - 4.9 in	3.3	0.4
5 - 8.9 in	16.7	4.6
9 - 12.9 in	23.3	16.2
13 - 16.9 in	5.0	6.1
17 - 20.9 in	5.0	10.2
21 - 24.9 in	1.7	4.3
25 + in	1.6	6.1
Total	56.6	47.9

3) Current conditions (post-treatment) - spatial patterns



Spatial analysis results (Stand 5A)

- 48% of the area to be managed for tree cover
  - 28% of the area is currently represented under mid-old tree crowns (tree drip-line measurement)
  - 20% of the area to be managed for recruitment and/or development of tree seedlings/saplings

- 52% of the area to be managed as open grass/forb/shrub

3) Modeled future conditions

a. Forest structure (FVS simulation)

FVS SIMULATION: natural growth, no treaments
SIMULATION DONE: 10-11-2011

AVERAGE* SUMMARY STATISTICS BY COMMON CYCLE

year	trees/ acre	basal area	stand density Index	dominant ht.	quadratic mean diameter	total cubic ft.	merch. cubic ft.	merc. board ft.	years	cubic ft. growth	cubic ft. mortality
2011	57	47	72	48	11.6	786	676	3075	10	37	1
2021	198	57	118	53	7.2	1149	1017	4993	10	41	2
2031	195	71	141	58	8.2	1547	1387	7081	10	43	2
2041	264	87	176	63	7.8	1963	1786	9306	10	44	2
2051	259	102	200	67	8.5	2379	2185	11570	10	44	2
2061	269	118	226	70	9	2801	2574	13847	10	41	4
2071	261	131	244	73	9.6	3171	2930	15998	10	38	10
2081	240	139	252	76	10.3	3449	3246	17887	10	36	9
2091	223	147	259	78	11	3717	3547	19354	10	34	8
2101	210	154	266	79	11.6	3968	3815	20799	10	31	8
2111	199	161	273	81	12.2	4196	4057	22137	0	0	0

- This simulation assumes no treatments or fire occurrence for 100 years. Natural regeneration is imputed at intervals, based upon stand density and characteristic ponderosa pine development. Numbers of trees reflect in-growth without the thinning effects of fire or other management. The limited assumptions of this simulation (no fire occurrence or tree-cutting) does not imply management intent, but is presented to show projected growth without disturbances for discussion purposes.

b. Fire Behavior (Flam Map simulation –based on 2011 conditions)

- Predicted surface fire on 99% of the area
- Predicted passive crown fire (torching) on 1% of the area

Campbell Blue River -Ponderosa Pine Forest Ecology, Apache National Forest

Purpose of Visit:

- View a ponderosa pine site where fire has shaped forest structure (natural regulation of regeneration).
- Discuss how and why the Wallow Fire affected the trajectory of this site towards the desired conditions.
- Discuss desired conditions for species composition, structure, and relationships to ecological function.

Background:

- Fire exclusion starting in the early 1900s.
- Probable light selection cutting during 1940-1990s period?
- Last harvest was a light cut in 1995 designed to promote tree regeneration in patches. Slash was piled and burned.
- Broadcast burned in 1999 (site preparation for regeneration).
- Natural regeneration observed to be established (2007).
- Wallow fire impacted the stand with a running head fire on May 31st.

Stand Data

1) **Aerial photo**

2) Current conditions

a. stand exam data, 10/2011)

Current averages per acre

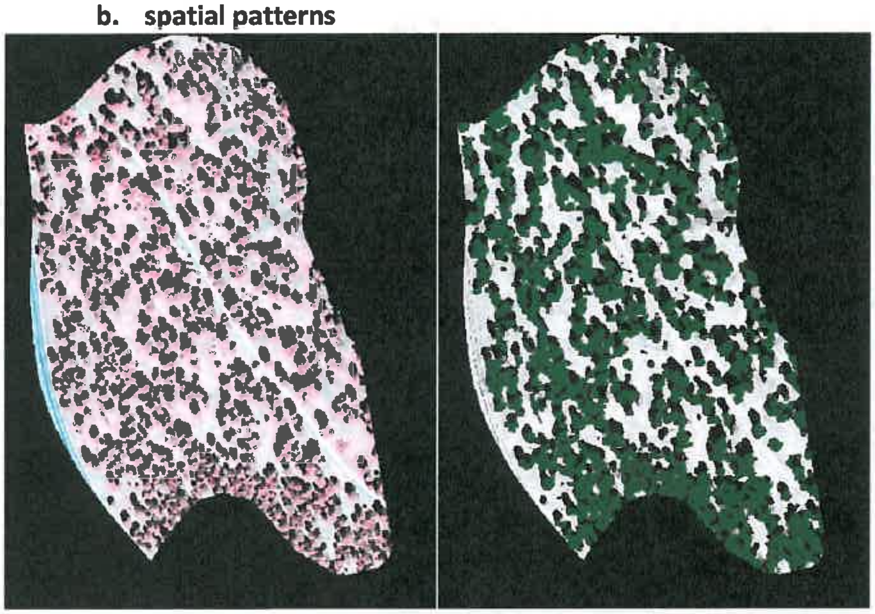
All Species Diameter Class	Trees/ Acre	Basal Area/ Acre
1 - 4.9 in	16.7	1.1
5 - 8.9 in	15	3.9
9 - 12.9 in	5	2.6
13 - 16.9 in	3.3	3.5
17 - 20.9 in	6.7	14.4
21 - 24.9 in	15	43.8
25 - 28.9 in	5	17
29 - 32.9 in	3.3	16.4
33 + in	3.3	20.3
Total	73.3	123.1

<u>Range of plot data:</u>

current trees per acre = 0 to 140
current basal area = 0 to 161 square feet/acre

historic reference condition trees per acre (based on current + historic evidences)
average = 33
range = 0 to 70

b. spatial patterns



- 39% of the area is under tree canopy (9.6 acres)
- 61% of the area is open grass/forb/shrub (14.8 acres)

3) Modeled future conditions (FVS simulation)

FVS SIMULATION: natural growth, no treaments

SIMULATION DONE: 10-11-2011

AVERAGE* SUMMARY STATISTICS BY COMMON CYCLE

year	trees/ acre	basal area	stand density Index	dominant ht.	quadratic mean diameter	total cubic ft.	merch. cubic ft.	merc. board ft.	years	cubic ft. growth	cubic ft. mortality
2011	73	123	181	83	17.5	3990	4005	23827	10	24	26
2021	134	124	205	83	13	3967	3986	23556	10	24	21
2031	131	126	206	82	13.3	3993	4011	23797	10	22	27
2041	157	126	214	81	12.1	3941	3955	23391	10	22	21
2051	153	128	216	80	12.4	3952	3967	23395	10	21	24
2061	171	129	221	80	11.7	3924	3933	23256	10	22	19
2071	167	131	223	80	12	3956	3966	23401	10	22	15
2081	173	134	230	80	11.9	4025	4031	23807	10	22	10
2091	171	140	236	80	12.2	4144	4138	24562	10	20	11
2101	166	144	241	80	12.6	4236	4218	25136	10	19	10
2111	161	148	245	80	13	4325	4315	25649	0	0	0

- This simulation assumes no treatments or fire occurrence for 100 years. Natural regeneration is imputed at intervals, based upon stand density and characteristic ponderosa pine development. Numbers of trees reflect in-growth without the thinning effects of fire or other management. The limited assumptions of this simulation (no fire occurrence or tree-cutting) does not imply management intent, but is presented to show projected growth without disturbances for discussion purposes.

Dry Mixed Conifer Forest Ecology, Apache National Forest

Purpose of Visit:

- Discuss classification and ecological differences between dry mixed conifer & wet mixed conifer forest types.
- View a dry mixed conifer forest site where the tree species composition and function has changed over time as a result of fire suppression and past vegetation management.
- Discuss desired forest species composition for dry mixed conifer forests, and relationships to ecological function.

Forest Type Classification - Southwestern Forest Types and Dominant Characteristic (Historical) Disturbance Regimes

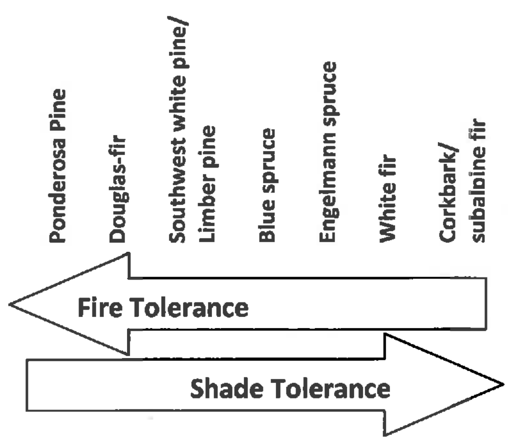
Forest Type	Fire Regime [1,2]	Fire Type [2]	Forest Structure	Seral Species	Climax Species
Ponderosa pine (and sub-types)	frequent/ low severity 2-17 yrs. (regime I)	surface	uneven-aged, grouped, open	ponderosa pine	ponderosa pine
Dry Mixed conifer/ frequent fire (warmer/drier)	relatively frequent/ low-mod severity 9-22 yrs. (regime I)	surface (common) mixed (rare)	uneven-aged, grouped, open uneven-aged, patched, open	dominant -ponderosa pine subdominant - aspen and/or oak (sub-stand scale patches)	fire dis-climax historic condition- shade intolerant species: dominant – ponderosa pine; subdominant - Douglas-fir, Southwestern white pine or limber pine
Wet Mixed Conifer/ infrequent fire (cooler/wetter)	relatively infrequent/ mod-high severity variable, 22-150 yrs. (regime III, IV)	mixed (common) stand-replacing (rare)	uneven-aged, patched, closed even-aged, closed	dominant – aspen or Douglas-fir, depending upon plant association habitat type	shade tolerant species, depending upon plant association habitat type: white fir, blue spruce
Spruce-fir (mixed, lower sub-alpine)	infrequent/ mod-high severity 150-400 yrs. (regime III, IV)	mixed/stand-replacing	even-aged, closed	dominant – aspen or Douglas-fir, depending upon plant association habitat type	shade tolerant species, depending upon plant association habitat type: Engelmann spruce, white fir
Spruce-fir (upper sub-alpine)	infrequent/ high severity 150-400 yrs. (regime IV, V)	stand-replacing	even-aged, closed	dominant – aspen, Douglas-fir or Engelmann spruce, depending upon plant association habitat type	shade tolerant species: Engelmann spruce and corkbark or sub-alpine fir co-dominate

[1] Schussman et al. 2006.
[2] Historical Range of Variation and State and Transition Modeling of Historic and Current Landscape Conditions for Potential Natural Vegetation Types of the Southwest. The Nature Conservancy: Southwest Forest Assessment Project. 2006.

Species Composition (on-site)

Tree Species (conifer)	Current age range of the most mature individuals on site	Estimated historic (1880) % of composition
Ponderosa pine	120 - 210 yrs. Avg. = 192	70%
Douglas-fir	180-220 yrs. Avg. = 200	25%
SW white pine	140-180 yrs. Avg. = 156	< 5%
Blue spruce	32-76 yrs. Avg. = 52	< 1%
White fir	0-20 yrs.	< 1%

Relative shade and fire tolerance of common conifer tree species in mixed conifer and spruce-fir forests



Eagar South Forest Restoration Project, Apache National Forest

Purpose of Visit:

- Discuss the concepts and various aspects of the desired conditions including: the degree of structural openness; the grass/forb/shrub matrix; the size (area, number of trees), shape, and spacing of tree groups; the interlocking crowns of trees within groups; the diversity and interspersion of tree structural (age, size) stages; and the sustainability of the desired conditions.
- Discuss and discuss how the Wallow Fire responded to the desired conditions for ponderosa pine forests.

Background:

- Demonstration sites represent ponderosa pine forests growing on moderately-productive (average) sites. Both sites have had fire exclusion since the 1890s; with the exception of slash burning following cutting in 1960 and 1988 and broadcast burns starting in 1994, and continuing through 1996.
- Area was part of the Mexican Hay Timber Sales (1959 and 1986), treated with light sanitation/salvage cutting (removal of diseased, dying and poor-formed trees). Visual buffer along Hwy 261 was left uncut. Some thinning of sapling trees (< 5 inches diameter) was completed in 1990 and 1991.
- Prescribed cutting treatments were implemented winter of 2007/2008. Treatments focused on moving towards desired conditions and ecosystem restoration; the variable outcomes among treated locations reflect natural variability in existing conditions and local treatment emphasis. Prescribed burning treatments were scheduled for fall/winter 2011/12.

Treatment Areas (post-treatment):

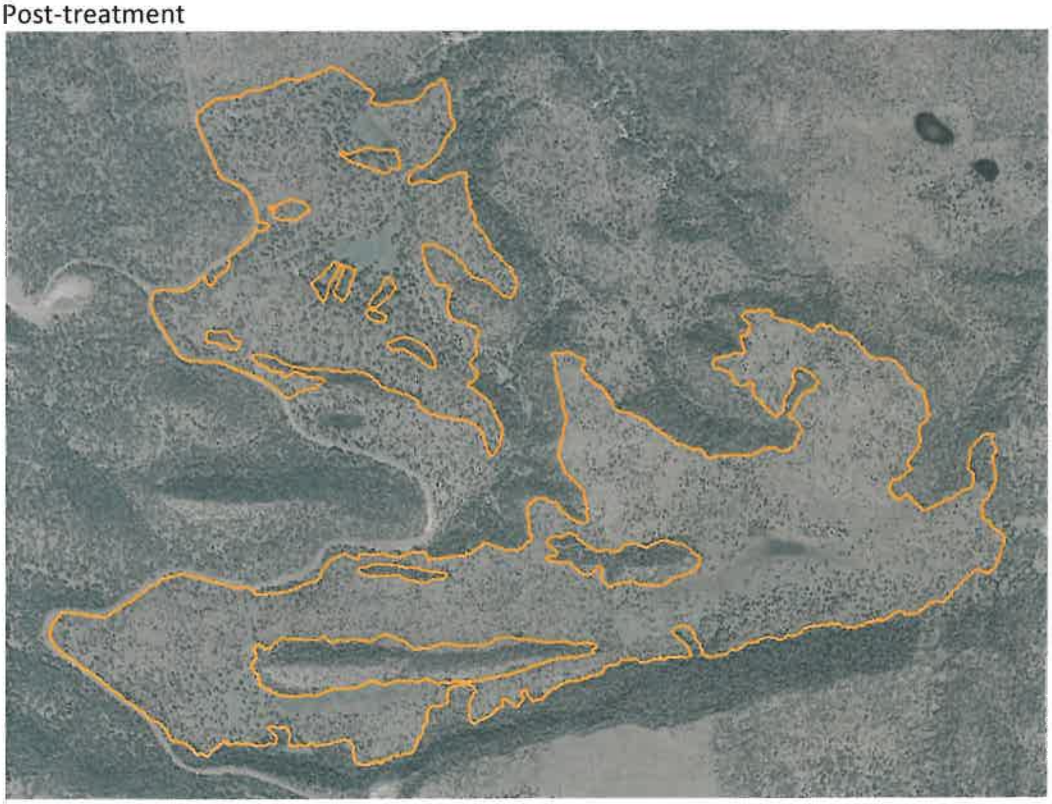
- Uneven-aged structure (3+ ages), roughly balanced area of young, mid, and old aged trees with provision of suitable openings for development of grass/forb/shrub component and localized recruitment of trees. Old age trees were below desired proportional representation before treatment, therefore none were cut.
- Desired spatial patterns are similar to natural conditions
  - Tree groups with interlocking crowns
  - Fine–scale dispersion of tree groups
  - Grass/forb/shrub openings
- Woody debris abundance is lower than desired.
- Tree densities (within group and per unit area) are within desired ranges (overall averages 30-70 sq. feet basal area).
- Seedlings have not yet established in desired locations.
- Desired grass/forb/shrub cover has not yet fully established.
- Modeled ***and observed*** fire behavior is low-intensity surface fire.
- Wallow Fire impacted the site on June 4th and 5th, drastically changing fire behavior from a running wind driven crown fire to a ground fire. 100% of the treatment areas were burned with variable, but primarily low severity fire effects.

Eagar South Forest Restoration Project – Data

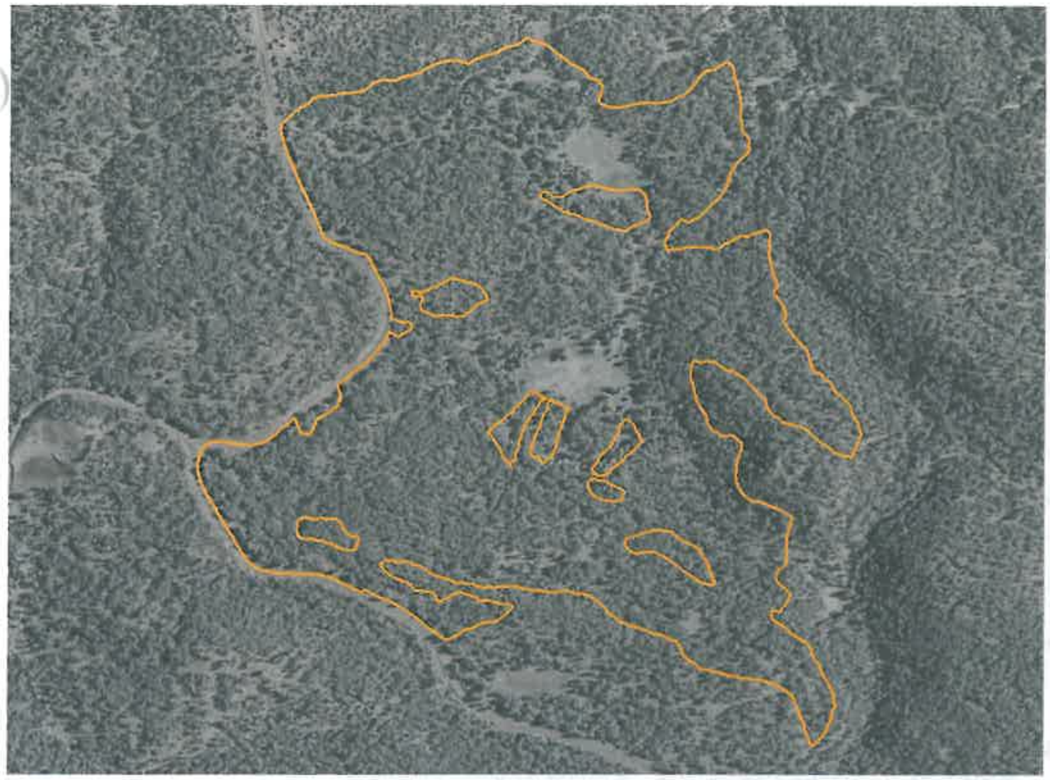
1) Aerial photos

Pre-treatment

Post-treatment



Pre-treatment

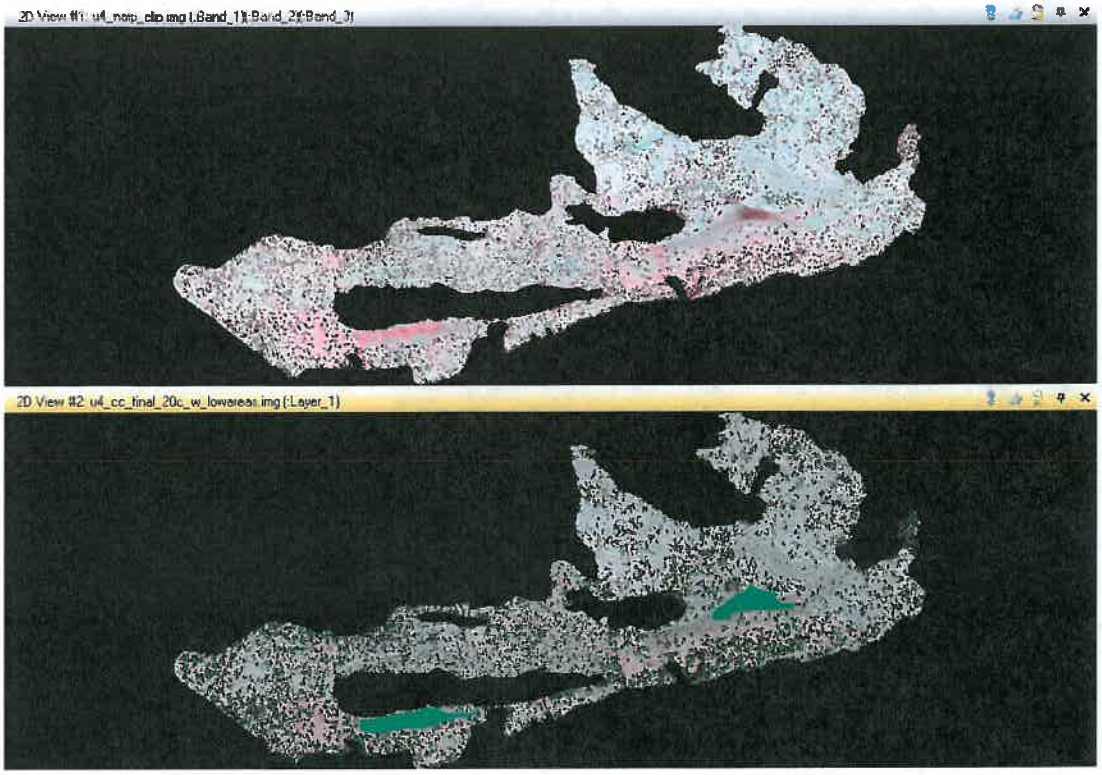


Post-treatment

2) Current conditions (post-treatment)

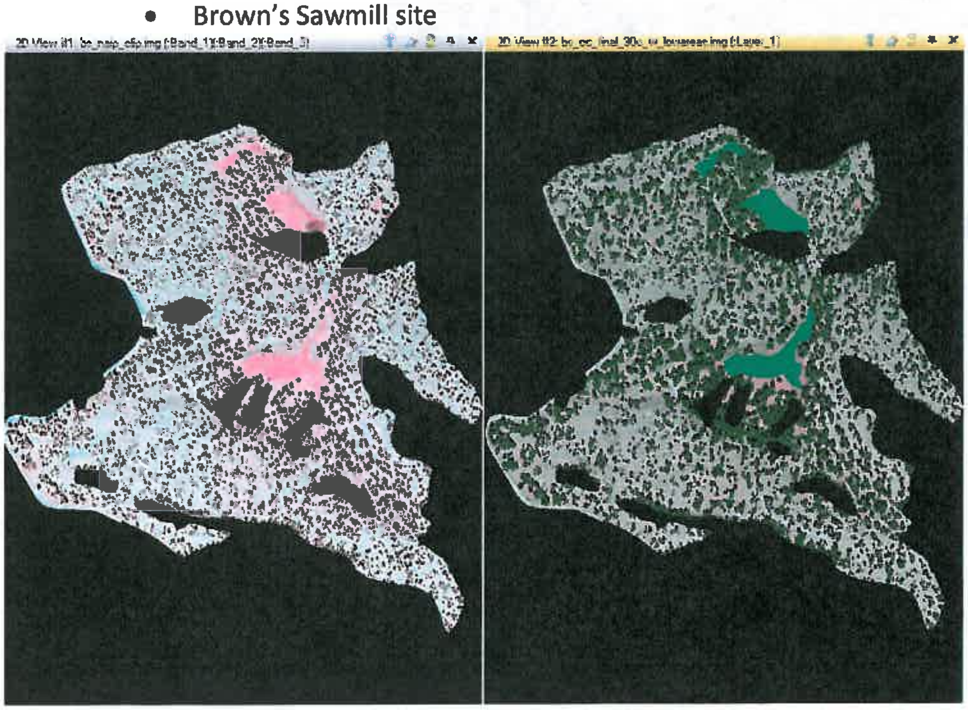
a. Spatial analysis from aerial photos

- Point of the Mountain Site



  - 11.5% of the area represented under mid-old tree crowns (tree drip-line measurement)
  - 88.5% of the area represented as open grass/forb/shrub (not including meadow areas shown in green)

- Brown's Sawmill site



  - 25% of the area is currently represented under mid-old tree crowns (tree drip-line measurement)
  - 20% of the area to be managed for recruitment and/or development of tree seedlings/saplings
  - 65% of the area to be managed as open grass/forb/shrub (not including meadow areas)

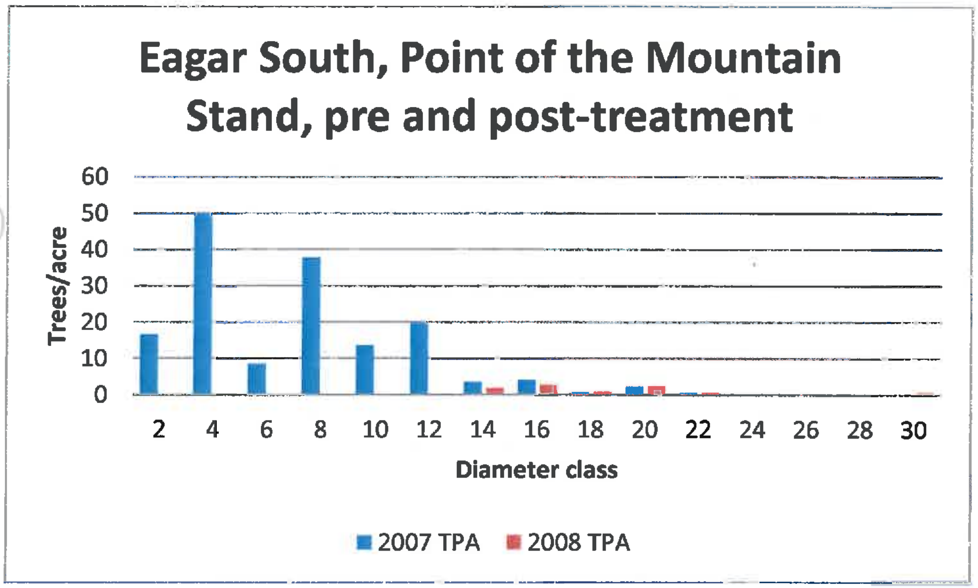
b. Stand exam data (2008)

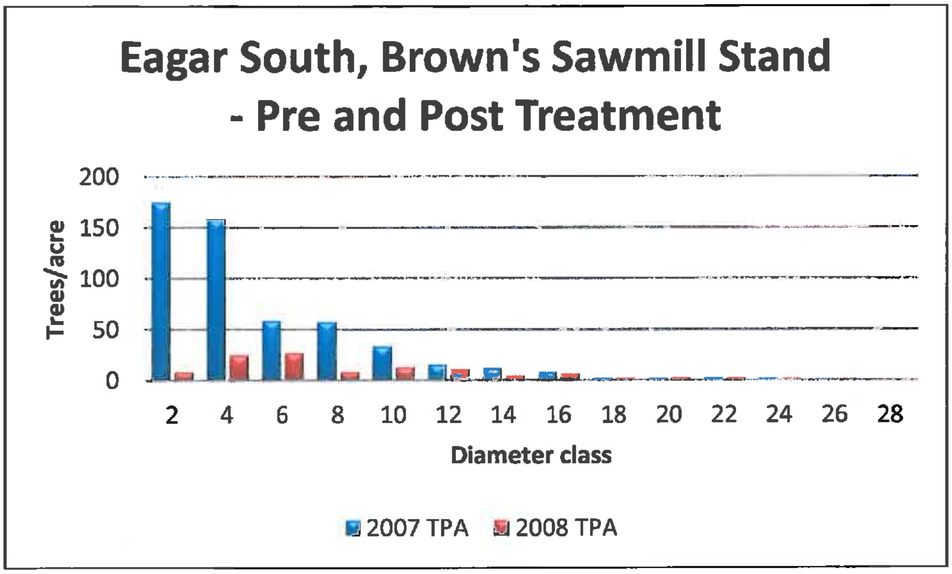
Point of the Mountain Stand, post-treatment

All Species Diameter Class	Trees/ Acre	Basal Area/ Acre (ft^2)
1 - 4.9 in	0	0
5 - 8.9 in	0	0
9 - 12.9 in	9.3	5.8
13 - 16.9 in	6.4	6.7
17 - 20.9 in	7.9	14.2
21 - 24.9 in	0.6	1.7
25 + in	0	0
Total	24.2	28.3

Brown's Sawmill Stand, post-treatment

All Species Diameter Class	Trees/ Acre	Basal Area/ Acre (ft^2)
1 - 4.9 in	33.3	2.0
5 - 8.9 in	35.0	6.7
9 - 12.9 in	23.2	13.3
13 - 16.9 in	10.0	11.7
17 - 20.9 in	4.4	8.3
21 - 24.9 in	4.3	11.7
25 + in	1.4	5.0
Total	111.7	58.7





3) Modeled future conditions (FVS simulation)

Point of the Mountain stand

year	trees/ acre	basal area	stand density Index	dominant ht	quadratic mean diameter	total cubic ft	merch. cubic ft	merc. board ft	years	cubic ft. growth	cubic ft. mortality
2008	24	28	45	55	14.7	593	521	2530	10	28	1
2018	166	38	83	39	6.5	857	776	3925	10	30	3
2028	162	48	98	43	7.3	1129	1035	5568	10	31	4
2038	276	58	129	46	6.2	1402	1303	7085	10	33	6
2048	263	70	147	50	7	1670	1535	8457	10	34	10
2058	316	81	173	52	6.9	1916	1791	9845	10	33	16
2068	291	90	184	54	7.5	2083	1983	10549	10	33	19
2078	306	97	198	56	7.6	2224	2109	11022	10	32	24
2088	274	101	200	58	8.2	2301	2174	11375	10	30	31
2098	279	101	200	59	8.1	2294	2150	11627	10	30	31
2108	241	100	194	60	8.7	2285	2151	11555	0	0	0

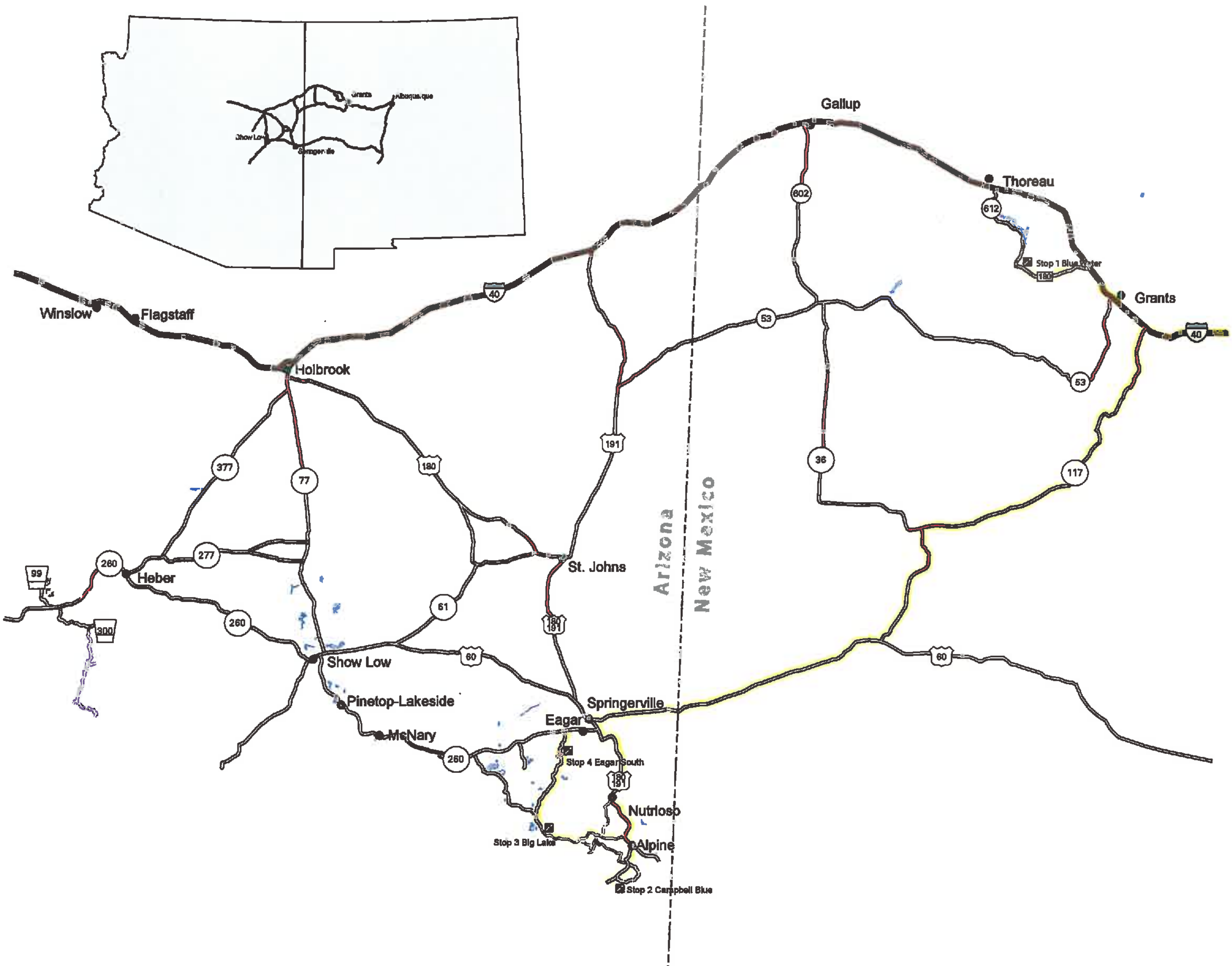
- This simulation assumes no treatments or fire occurrence for 100 years. Natural regeneration is imputed at intervals, based upon stand density and characteristic ponderosa pine development. Numbers of trees reflect in-growth without the thinning effects of fire or other management. The limited assumptions of this simulation (no fire occurrence or tree-cutting) does not imply management intent, but is presented to show projected growth without disturbances for discussion purposes.

Brown's Sawmill stand

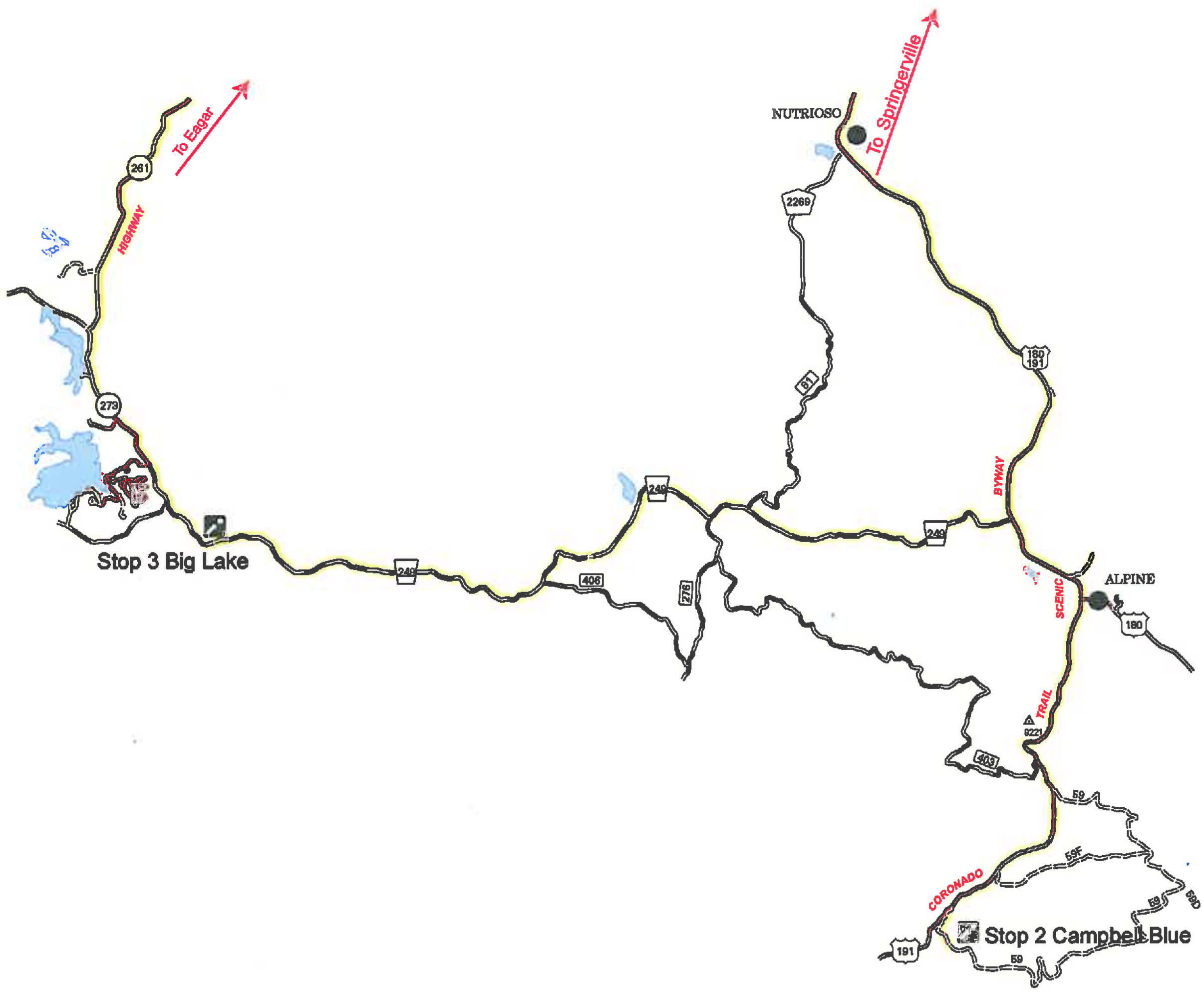
year	trees/ acre	basal area	stand density Index	dominant ht	quadratic mean diameter	total cubic ft	merch. cubic ft	merc. board ft	years	cubic ft. growth	cubic ft. mortality
2008	112	59	108	54	9.8	1231	1085	5126	10	38	3
2018	231	74	150	58	7.7	1577	1426	6760	10	40	4
2028	224	88	173	61	8.5	1939	1777	8629	10	41	5
2038	261	103	201	63	8.5	2298	2103	10604	10	39	3
2048	255	117	222	65	9.2	2654	2446	12502	10	38	9
2058	244	128	237	67	9.8	2943	2721	14281	10	34	11
2068	226	136	245	69	10.5	3172	2926	15775	10	32	13
2078	211	143	251	71	11.1	3364	3112	16868	10	31	11
2088	199	151	259	72	11.8	3565	3333	17965	10	30	12
2098	188	157	265	72	12.4	3748	3533	19047	10	27	11
2108	179	163	270	73	12.9	3905	3695	19891	0	0	0

- This simulation assumes no treatments or fire occurrence for 100 years. Natural regeneration is imputed at intervals, based upon stand density and characteristic ponderosa pine development. Numbers of trees reflect in-growth without the thinning effects of fire or other management. The limited assumptions of this simulation (no fire occurrence or tree-cutting) does not imply management intent, but is presented to show projected growth without disturbances for discussion purposes.

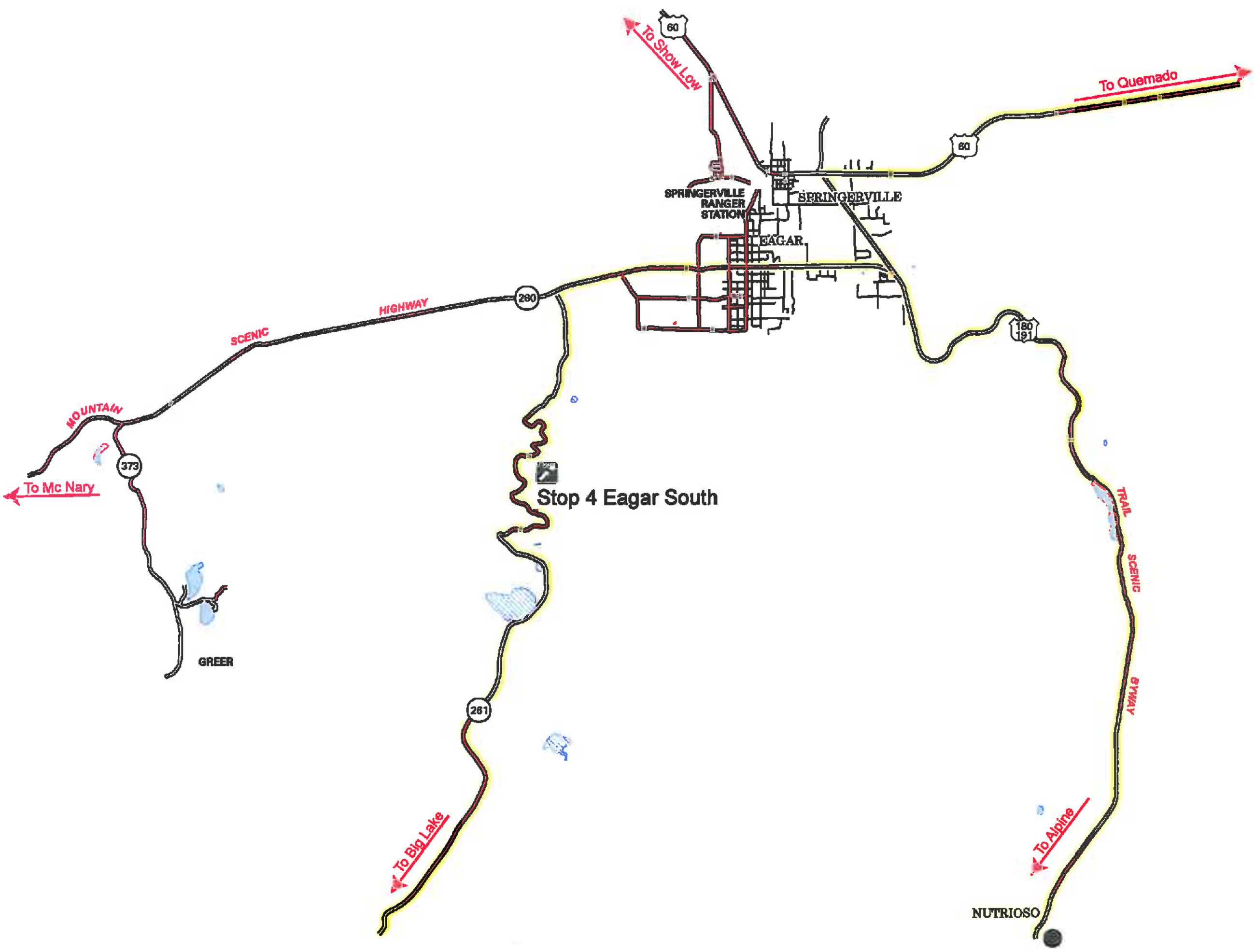
Stop 1 Blue Water
180
Grants
40
53
53
36
117
To Springerville
QUEMADO
60



Grants
Albuquerque
Show Low
Springerville
Gallup
Thoreau
Stop 1 Blue Water
Grants
Winslow
Flagstaff
Holbrook
Heber
Show Low
Pinetop-Lakeside
McNary
St. Johns
Springerville
Eagar
Stop 4 Eagar South
Nutrioso
Alpine
Stop 3 Big Lake
Stop 2 Campbell Blue
Arizona
New Mexico



To Eagar
261
HIGHWAY
273
Stop 3 Big Lake
249
406
276
NUTRIOSO
To Springerville
2269
81
180
191
BYWAY
249
ALPINE
SCENIC
180
TRAIL
9221
403
59
59F
59
59D
CORONADO
Stop 2 Campbell Blue
191
59



60
To Show Low
To Quemado
60
SPRINGERVILLE
RANGER
STATION
SPRINGERVILLE
EAGAR
260
HIGHWAY
SCENIC
MOUNTAIN
To Mc Nary
373
180
191
Stop 4 Eagar South
TRAIL
SCENIC
GREER
261
BYWAY
To Big Lake
To Alpine
NUTRIOSO

Workshop Evaluation Form

DESIRED CONDITION WORKSHOP
OCTOBER 26-27, 2011

1. **The Regional Forester Perspective on DC, Landscape Scale Restoration by Corbin Newman was:**

   5 (Helpful)   4   3   2   1 (Not Helpful)

   Comments:

2. **The Setting the Stage for Desired Condition Dialogue by Wally Covington was:**

   5 (Helpful)   4   3   2   1 (Not Helpful)

   Comments:

3. **The Desired Condition Description presentation by the DC Team was:**

   5 (Helpful)   4   3   2   1 (Not Helpful)

   Comments:

4. **The Panel Discussion was:**

   5 (Helpful)   4   3   2   1 (Not Helpful)

   Comments:

5. **The Field Trips were:**

   5 (Helpful)   4   3   2   1 (Not Helpful)

   Comments:

6. **The written materials were:**

   5 (Helpful) 4 3 2 1 (Not Helpful)

   Comments:

7. **Overall, was the information presented at this conference relevant and useful to you? If not, please explain or recommend changes.**

   5 (Helpful) 4 3 2 1 (Not Helpful)

   Comments:

8. **How will you use what you have learned from this workshop?**

9. **Any other comments?**

Thank you for completing this evaluation form!

Region 3 FS Desired Conditions Workshop
October 2011

Presentation or Stop #	Name (Optional)

Does this site meet your expectations of desired conditions? Why or why not?

Comments: