STAND DIAGNOSIS of TREATMENT NEEDS,

SILVICULTURAL PRESCRIPTION

And

SILVICS BACKGROUND PAPER
(effects analysis)

<u>JIM'S CREEK SAVANNA RESTORATION PROJECT</u>

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Glossary:

Since savanna restoration is a rather new concept, some of the terminology used in this report may not be especially clear to all readers. In the interest of clarity, the following terms used in this report are defined:

Cohort – the complement of vegetation (usually trees) which has developed at the same time, generally after a disturbance. Typically a cohort is referenced by its age, e.g. the 100 year old cohort, that portion of a multiple-aged forest that developed at the same time after, for example, a fire.

Condition Class – the condition of a plant association or assemblage relating to changes in its historic fire regime. Condition Class I indicates the fire regime has not changed much, Condition Class III implies a number of historic fire return intervals have been missed, usually as a result of fire suppression efforts. These conditions can have an influence on the type, amount, and structure of the vegetation type, and the risk that future wildfire may burn in a more severe fashion than have historic fires on the same landscape.

Fire regime – The fire environment a given ecosystem or plant assemblage is subject to, either currently or in the past (as such regimes can change). Typically fire regimes are expressed as some sort of fire frequency, (such as frequent, infrequent, or a range of the average number of years between fires), and degree of fire severity (as in low, moderate, mixed, high, or severe) in relation to how much vegetative mortality they cause.

Garry Oak – Another common name for Oregon White oak (*Quercus garryanna*)

Legacy tree – A tree, of any size or species, that was present on this slope more than 120 years ago. These are trees which have obviously been exposed to fire as evidenced by charred bark, fire scars, etc, or exhibit crown and branching forms indicating they were substantially open-grown at one time.

Matrix – A Northwest Forest Plan (USDA.USDI, 1994) land allocation: those lands where programmed timber harvest may occur.

Restoration – To return to a previous condition

Savanna – a grassland containing scattered trees; typically the trees are open-grown, with crowns that do not touch.

Silviculture and Silvicultural – The science of the management, culture and growing of trees; Forestry: of or pertaining to activities that facilitate silviculture.

Snag – A dead tree of any size, configuration or condition. Snags can be recently dead and relatively sound trees to long dead trees within considerable deterioration, including the loss of a goodly portion of their upper stems.

Stand – A group of trees in a forest that have a similar structure and age, usually as the result of developing under the same disturbance regime.

I. STAND DIAGNOSIS of TREATMENT NEEDS

A. Introduction

This report presents the data collection, current conditions, and analysis used to identify the fact that this portion of the landscape has changed so dramatically from what it was 100 years ago, as well as the rationale used to identify the Desired Future Condition of this part of the landscape. This information establishes a diagnosis of existing forest conditions and contains a summary of land management objectives relating to the Purpose and Need for Action. This report provides a prescription for achieving the desired future conditions. That prescription covers the physical and logistical implementation of the recommended tree removal and subsequent cultural activities such as slash disposal, regeneration of Oregon white oak and native bunchgrasses, and future maintenance burning that comprise the preferred alternative addressed in the Jim's Creek Savanna Restoration Stewardship Project Environmental Assessment (EA). It also presents the rationale behind why various prescriptive elements are proposed, and contains a background discussion addressing objectives, alternative effects, and silvicultural concepts applicable to the proposed savanna restoration harvest, should an action alternative ultimately be selected for implementation.

The prescribed silvicultural activities contained in this report have been developed to specify how excess tree removal should occur in areas proposed for management by the tentatively preferred alternative (Alternative E) in the Jim's Creek EA. Should another alternative be selected for implementation, some of the prescriptive detail contained herein would have to be changed, but in general the concepts presented in this discussion and prescription apply to harvest proposed in all developed action alternatives presented in the Jim's Creek EA. While the contents of this paper to a certain extent comprise a background of information and rationale for what is presented in the Jim's Creek Environmental Assessment, it is suggested that the EA be reviewed before or concurrently with this report.

The Jim's Creek Savanna Restoration project planning area occurs in the upper portion of the Hill's Creek 5th field watershed, a portion of the larger Middle Fork of the Willamette River watershed. The planning area occurs within a larger landscape that has come to be known as the Middle Fork Mixed Conifer forest type (as delineated by Agar, 1998). This is a forest type unique on the Willamette National Forest, though it is similar to forest stands that occur more commonly on the Umpqua National Forest to the south of the Middle Fork watershed. The mixed conifer forest type is so named because it contains a mixture of ponderosa pine, sugar pine, and incense cedar along with the more dominant Douglas-fir. This forest type was at one time a more open forest than it is now, and likely contained an open understory of grasses, forbs and some shrubs (Winkler, 1984, Winkler and Bailey, 2002, Bailey and Kertis, 2002). The Jim's Creek Planning area is a sub-set of this type and was likely even more open than mixed conifer type as a whole.

The Middle Fork Willamette Downstream Tributaries Watershed Analysis (USDA, 1995) recognized the uniqueness (page 1-4) of the above mixed conifer forest type and recommends (page 6-2) that management strategies be developed to maintain the functions of that open forest habitat. The Integrated Natural Fuels Management Strategy (USDA/USDI., 2000) also recognized the importance and rarity of pine and oak dominated sites (page 15), established the desired to maintain and restore such habitats (Appendix D-2), and recommended that oak and pine stand may need treatment to provide for retention of oak, pine and native vegetation. While both these integrated resource analyses recognized the importance of the open mixed conifer and oak forest for diversity and fire regime condition class, and recommended in some sense that treatments be conducted to restore forest type which has been changed so dramatically by fire exclusion, nether specifically identified any specific area within the Middle Fork mixed conifer type for any type of treatment. The changes which have occurred specifically in the Jim's Creek project area were first noticed by this author during a casual visit to the area. Subsequent study of various documents to determine the significance and uniqueness of this degraded savanna type, including those mentioned above, and consultation with local Fire Ecologist Jane Kertis (See Bailey and Kertis, 2002) led to presentation of this savanna restoration proposal to the Middle Fork District Ranger and his staff. The District Ranger formally decided to pursue this proposal in April of 2004.

The planning area is located on southerly slopes about eight miles upstream of the upper end of Hill's Creek Reservoir and contains about 690 acres. Elevations in the project area range from 1920 to 3280 feet. It encompasses a number of stands as delineated in the District's VEGIS database (Geographic Information System vegetation layer), as follows. More than half of the planning area (about 64%) is represented by one stand, #2656 (over half of this stand is outside the planning area). Other forested stands include stand numbers 2804, 2794, 6829, 2770, 7519, and 2716. As best I can tell, the above stands were separated from stand 2656 due to subtle differences in residual tree density, caused by a slightly lower or higher level of mortality in the savanna legacy trees. Stand number 6829 seems to have been delineated to record the fact that a small amount of windthrow mortality was savaged from it about 20 years ago. None of these smaller stands differ significantly from #2656 and from my field reconnaissance all seem to have been subjected to the same disturbance regime and development pathway. These stands also contain essentially the same plant associations, as discussed below under Current Vegetation Conditions. Residual tree density, both now and in the past, is and was fairly random across the entire planning area. The current variation in older tree distribution is at least as variable and maybe even more variable within a given stand than it is between stands. I therefore will address these stands as one in the remainder of this report.

The area also has four stands, # 2798, 2772, 2810, and 2696, that were created by timber harvest about 20 years ago, the first two being clearcuts that regenerated primarily to ponderosa pine, and the second two being shelterwoods which contain an average of 22 overstory trees per acre and regenerated to mixed conifer stands. The area also contains a number of non-forest or "special habitat' vegetation types, consisting primarily of dry, somewhat rocky meadows (stand numbers 2793, 2743, 7461, 2463, 2719, 7462, and 2830) totaling about 23 acres of delineated stands and several more acres of non-delineated, smaller meadow types. Some of the activities addressed in this report will occur in these meadows habitats, and some tree removal will occur in the largest of these typed meadows (2743) as it has been encroached upon considerably, primarily by ponderosa pine, in the 100 years since fire suppression began in this area.

The vegetation on these slopes generally consists of 100 year old Douglas-fir stands which have a scattered overstory of 200 to 400 year old trees averaging about five per acre, though they are not evenly distributed across the landscape. This older overtory consists primarily of Douglas-fir and ponderosa pine with some incense cedar, most of which exhibit branching form indicating open growth earlier in their life. Many of these older trees also exhibit charred bark or basal fire scars indicating they have experienced fire in the past.

Prescriptive elements presented in this report were discussed with the project's Interdisciplinary Team and represent a consensus of that Team. These prescriptions comply with management direction and mitigating measures contained in this EA. It also implements the Forest Wide (FW) and Management Area (MA) standards and guidelines contained in the Willamette National Forest Land and Resource Management Plan (USDA 1990a), which start on page IV-44 unless specifically exempted by the forth-coming decision. Specific Willamette National Forest Plan and Northwest Forest Plan (ROD; USDA/USDI, 1994) standards and guidelines are referenced in parentheses.

B. <u>Land Management Objectives</u>

The Purpose and Need for Action, as discussed in the Jim's Creek Savanna Restoration Project EA, details the reasons for this proposal to restore the savanna vegetation in this area. The discussion below includes some of the specific land management objectives contained in the Willamette National Forest Land and Resource Management Plan (USDA, 1990a) that support the overall purpose and need for restoration. With the above purpose and need in mind, and considering Forest Plan objectives, the silvicultural objectives for the restoration of savanna conditions through the harvest of timber, are as follows:

1) To maintain and restore the vegetative and wildlife diversity that existed when this area was dominated by a savanna vegetation structure.

2) To maintain the productivity of the sites proposed for harvest by minimizing soil erosion, compaction, and displacement and by maintaining or restoring existing nutrient cycles (FW-079 to 085). This is to be kept in mind during removal of trees, reduction of fuel loading, and subsequent cultural activities.

3) To provide for the retention of other resource values while accomplishing stand management in matrix lands (ROD, page C-40 to 42, B-5 and 6). Some areas, such as riparian areas and special habitats (See page C-41 of the Northwest Forest Plan ROD, MA-15, and FW-211) may be treated in a different way than "matrix" forest land but if trees need to be cut to achieve objective #4 below, the removal of these trees may be desirable in order to provide a means (i.e. funding) to accomplish the necessary structural changes.

4) Provide for protection and restoration of riparian reserves as defined on page C-30 and 31 of the Northwest Forest Plan ROD and the Middle Fork and Downstream Tributaries Watershed Analysis (USDA, 1995).

5) Return the Fire Regime and fire regime Condition Class (USDI, 2005) to its historic condition of frequent, low-severity fires. Restoration of this fire regime would maintain the restored savanna in its open condition and reduce the likelihood of stand replacement wildfire.

The overall need for removing trees in this area is driven by the desire to return this portion of the Middle Fork landscape to its previous, savanna-like condition in order to maintain the historic vegetative and wildlife species diversity, and to provide for continuation of its cultural significance (see Winkler and Bailey, 2002). The Desired Future Condition narrative below summarizes the reasons for wanting to restore this piece of forest to its original, more open condition.

The proposed harvest occurs in Matrix lands (USDA/USDI, 1994, page C-39), as well as from those areas designated as Riparian Reserves. The Willamette National Forest Plan (USDA, 1990a) classifies the planning area into the following Management Areas: General Forest (MA 14a), or Scenic - Partial Retention Middleground (MA 11c), Scenic - Partial Retention Foreground, and Special Habitat Area (9d). General management guidelines for these Management Areas are as follows:

<u>Special Habitat Areas (MA 9d)</u>:
A portion of the project area associated with the large meadow complex has been delineated as a special habitat area. Interestingly, the boundary does not include all the meadows in the vicinity and appears to have been drawn in a fairly arbitrary manner. The Goal for this management area (Forest Plan page IV-177) is to protect and enhance unique habitats and botanical sites. The desired future condition is to have a well distributed network of high quality habitats that provide unique characteristics and diversity to the landscape; natural processes will prevail without human intervention. Specific Management Area standards and guidelines provide for harvest if it is needed to meet established wildlife objectives (MA-9d-09), habitats of native wildlife and plants shall be maintained, and boundaries should include buffers that generally are greater than three tree heights to provide for habitat protection.(MA-9d-07). In addition, a Special Habitat Management Guide has been prepared (Dimling and McCain, 1996) to direct how these habits should be protected and/or treated.

<u>Scenic lands (MA 11c and 11d):</u>
The middle slopes of the Jim’s Creek area are allocated as Scenic - Partial Retention Middleground by the Forest Plan (Management Area 11c). The desired future condition for this land classification is to maintain a natural setting, but such that management activities will be noticeable in the middleground and background as viewed from major travel routes. The lower slopes of the planning area are allocated as Scenic - Partial Retention Foreground by the Forest Plan (Management Area 11d). Resource management treatments are to be conducted such that they are visually subordinate to the characteristic landscape. Tree removal is proposed in General Forest and Scenic – Partial Retention stands to accomplish the above objectives, in addition to making the stands more biologically diverse as directed in FW 201 and 207 (USDA, 1990a, pages IV-78 and 79).

<u>Matrix/General Forest lands (MA 14)</u>:
The desired future condition for young stands in General Forest lands (USDA, 1990a, page IV-227) is to “maintain vigor and growth using [among other techniques] commercial thinning”, and

to produce commercial quantities of timber (FW-176, 177). The desired condition also states that "managed stands will generally consist of a well-stocked understory with a scattered mix of large snags and green replacement trees". This is one example of where Forest Plan standards for maintenance of biodiversity conflict with other objectives, as further discussed below. Matrix lands are those designated y the Northwest Forest Plan (page C-39 of the Standards and Guidelines; USDA/USDI, 1994) as those lands where most timber harvest and other silvicultural activities would take place.

Riparian Reserve lands (MA 15):
The Jim's Creek project area contains riparian reserves as described in USDA/USDI, 1994, page B-14 and USDA, 1995, Appendix K along Deadhorse Creek on the eastern edge of the area and along Jim's Creek in the center of the area and eight other unmapped class IV streams. The desired future condition for riparian reserves (Forest Plan page VI-223) is to provide a diverse habitat for aquatic species as well as maintaining water quality, and to contain diverse stands of conifer and hardwood vegetation which provide habitat for riparian dependant species, as well as to prevent future wind and snow damage in very dense stands. The Northwest Forest Plan (USDA/USDI, 1994, page C-32) directs us to apply silvicultural practices in riparian reserves to develop desired vegetation characteristics needed to attain Aquatic conservation Strategy Objectives (Page B-11). Specifically, savanna restoration in the form of tree removal needs to occur to accomplish Aquatic Conservation Strategy Objective #1; "maintain and restore the distribution, diversity, and complexity of watershed and landscape scale features…" and #8, "maintain and restore the species composition and structural diversity of plant and animal communities in riparian areas…." and #9 " maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependant species."

Forest Wide Standards and Guidelines

The Willamette National Forest's Land and Resource Management Plan (USDA, 1990) contains general guidelines for maintaining biodiversity across the landscape;

FW-201: Biological diversity ***shall*** be maintained or enhanced by providing ecologically sound distribution and abundance of plant and animal communities…. This distribution will contribute to the goal of maintaining all native….species and communities.

FW-207: During project planning, site-specific analysis ***shall*** consider biological diversity and ecosystem function.

FW-211: Special wildlife and plant habitats….***shall*** be maintained….examples of special habitats include…. unique plant associations.

In addition, standards and guidelines for land management area **9d –** Special Wildlife Habitat habitats of native wildlife and plants ***shall*** be maintained **(MA-9d-07)**. All above emphases are added.

It should also be noted that there are reasons other than general biodiversity to accomplish this restoration. There are social reasons relating to Native American cultural traditions and historic settlement activities, and this restoration proposal will have a beneficial effect in providing a permanent foraging area for big game in an area and era where early-successional vegetation is seldom produced except as a result of unplanned (in time and space) wild fire.

Potential Incompatibility Between Management Area and Forest Wide Standards and Guidelines

The Management Area standards and guidelines for timber harvest on General Forest and scenic areas are more or less oriented towards even-aged regeneration harvest associated with timber volume production, and as such do not apply very well to restoration of historic conditions. Certain guidelines for Management areas 11c, 11d, and 14a can be construed to prohibit or limit the amount of restoration that has been proposed in this project. For example, how would one restore a savanna vegetation type by removing a substantial portion of the trees on that site and still comply with MA-11d -07 (Forest Plan page IV-208) which says that even-aged regeneration harvest units should not exceed 8 acres in size? The literal answer is that the currently proposal is not an even-aged regeneration harvest unit, yet few more large tree would be retained in the savanna restoration than would be in the typical regeneration harvest unit under the Northwest Forest Plan standards and guidelines, given green tree retention requirements.

Special Habitats - As mentioned above, the desired condition for special habitats is that natural processes will prevail without human intervention, yet harvest is provided for if it is needed to meet established wildlife objectives. The “without human intervention” component of the desired conditions is rather confusing, especially in the case of this proposal, since many special habitats are an artifact of fire, and possibly human generated fire, so to maintain these habitats they do not need to be protected from any human activity, but may need to received periodic prescribed fire treatment. The Forest Plan directs (page IV-178) that buffers greater than three tree heights wide should be emplaced to provide for habitat protection, implying that all special habitats have and/or require specific microclimates around their perimeter to function properly. In the case of this savanna restoration project, a literal interpretation of these guidelines would result in buffering of all meadows large and small in the project area with buffers as wide as 450 feet, which in many cases would be more than twice the width of the meadow habitat in the first place. If such protective buffers were emplaced around the meadow habitats in the Jim’s Creek project area, little restoration of the original savanna type could occur. It will hopefully become obvious in the following discussion of current and past conditions and the need for restoration in the first place that the entire Jim’s Creek area could at one time have been considered a special habitat area, and that the proposed activities need to occur immediately adjacent to and even within the many small meadows to facilitate restoration of existing conditions and maintenance of biodiversity. These observations apply to the small meadows that are not within the areas designated as 9d since FW-211, which directs maintenance of special habitats not especially allocated for protection by providing them with a buffer to maintain the microclimate of the site.

In addition, FW-193 (USDA, 1990, page IV-76) specifies that “forest openings created by even-aged silviculture should not exceed 60 acres unless otherwise justified”. It could be construed that the preferred alternative (Alternative E), and other alternatives as well, would be in violation of this standard and guideline. Though the forest remaining under the preferred alternative would be quite open (but in my mind not be a “forest opening”), the proposed action does not constitute even-aged silviculture. After all proposed activities are completed there will remain on the areas treated at least three age classes of trees. Over the years as this savanna continues to develop, there will be a wide range of tree ages occupying the area. Though there will be relatively few younger trees at any given time, there will be enough in the younger age classes to provide for eventual replacement of mature savanna trees. Even if one were to establish that this open forest would indeed constitute a "forest opening", this report and the narrative and analysis in the EA have established the justification required to depart from this guidelines

There is a discussion of the differences in the use of the words **"shall"** and **"should"** in the Standards and Guidelines on page IV-45 of the Forest Plan. The use of "shall" indicates the action is "mandatory at all times", while "should" indicates the action is required unless "justifiable reason exists for not taking action". It should be noted that the Forest-Wide biodiversity objectives all use the word "shall", while most others contain the word "should". The Jim's Creek Savanna Restoration Interdisciplinary Team is of the opinion that this wording difference indicates the biodiversity guidelines take precedent over Management Area goals, should any conflicts be construed.

C. <u>Desired Future Condition</u>

The following discussion is taken from a paper written by this author and Jane Kertis, Forest Ecologist for the Siuslaw and Willamette National Forests, entitled "Jim's Creek Savanna: The Potential for Restoration of an Oregon White Oak and Ponderosa Pine Savanna" (Bailey and Kertis, 2002). This document was integral in developing the Purpose and Need statement contained in the Jim's Creek Savanna Restoration environmental assessment. A copy of the document is contained in the Analysis File for this project.

Given the unique circumstances of the Jim's Creek area, the recent emphasis on maintaining and restoring plant and animal habitat diversity, the current very reduced occurrence of Oregon white oak and ponderosa pine habitat (ODF, 2004; Oregon Biodiversity Project, 1998), and the general recommendations contained in The Middle Fork Willamette Downstream Tributaries Watershed Analysis (USDA, 1995) and The Integrated Natural Fuels Management Strategy (USDA/USDI., 200), the desired future condition of this unique portion of the landscape is that which appears to have existed about 100 plus years ago (see page D-2 of Appendix D, USDA/USDI, 2000 and page 6-2 of USDA, 1995). At that time, this area supported an open forest containing an average of ten to 15 mature trees per acre composed of ponderosa pine, Oregon white oak, and Douglas-fir in relatively equal amounts. This tree coverage was not especially uniform in terms of spacing and there were likely widely scattered clumps of smaller trees. The understory was dominated by bunchgrass and a number of flowering plants in season, and there would have been little to no woody material on the grassy forest floor. It was likely a very pleasant place to be and a place which provided habitat for a number of important species of mammals, birds and reptiles that are absent or not as common on the landscape now.

The ground fuels should be very low, consisting mostly of cured grasses, such that periodic burning could be easily, safely, and economically used to maintain the open nature of the stand. Maintaining this area in a condition allowing for frequent, low severity fires would prevent the slopes from again converting to a closed canopy of young Douglas-fir.These conditions are desirable for the following reasons:

- It would provide for maintenance of both Oregon white oak and ponderosa pine, both of which are relatively unusual in the context of the Willamette National Forest, and are a rare vegetation assemblage now within the entire Willamette River basin;
- In addition to the above, it would conserve what may very well be the unique genetic heritage of these tree species which occur on the edge of their range. Conservation of the genetic legacy of these species may be especially important given the possibility of future climate change;
- It would provide for a more or less permanent forage area for wildlife requiring open, grassy forests, or a substantial amount of oak mast, such as elk, deer, acorn woodpeckers, etc.;
- It would be a very aesthetically pleasing landscape;
- It would maintain a vegetation type likely created by indigenous peoples and provide for continued use for collection of traditional food and craft materials;
- It would essentially fire-proof this part of the landscape in terms of preventing high tree mortality wildfire in the future, and potentially serve as a fire break to reduce the spread of severe fire from outside the Jim's Creek area.

This desired condition is strictly a matter of social value, as reflected by the biodiversity objectives mentioned at the beginning of this report. The land contained in the Jim's Creek project area seams to be perfectly capable of supporting a closed canopy stand of Douglas-fir from a forest health perspective. It should also be noted that the desired 15 large trees per acre mentioned above is not a magic number inherently natural to this site. That tree density is simply what existed on this site some 120 years ago, a snap shot in time so to speak, and as such is just a template for us to use in recognition that conditions have changed dramatically on this portion of the landscape. We do know that such a tree density will provide for the continued presence of large Oregon white oak in this forest. It is quite likely that this area had less than 15 large trees per acre at some time in the past, and it may be that it had more, though likely not much more given that oaks have persisted on the site.

A more detailed Desired Future Condition statement can be found in the Jim's Creek Savanna Restoration project EA, and a more specific Desired Future Condition that facilitates evaluation of alternatives, specific stand treatment recommendations, and development of monitoring standards is presented in the following Silviculture Prescription.

D. <u>Vegetation Conditions</u>

The 688 acre Jim's Creek stand is set in a larger landscape of mixed conifer forest. Unique within the Willamette National Forest, the Middle Fork watershed contains about 25,000 acres of ponderosa pine/sugar pine/Douglas-fir stands which typically occur south of Hills creek reservoir in lower elevations and southerly slopes (Agar, 1998). According to historical accounts (Winkler, 1984, Winkler and Bailey, 2002) and as can be deduced from the forests' structure, these mixed conifer stands were at one time more open than they are today. At one time they supported a more or less fire resistant overstory of large ponderosa pine and Douglas-fir, with some scattered sugar pine. Even without historic accounts, the crown structure of these legacy trees indicates the once open nature of this forest The large and relatively low branches(the later being now mostly dead) on the Douglas-fir and ponderosa pine, as well as the heavy lateral braches of the many dead and down oaks, show these trees, for the most part, grew without aerial competition over 100 year sago

Portions of the Jim's Creek stand were perhaps even more open than the rest of the mixed conifer type. This fact is evidenced by the presence of large diameter white oak stems that still remain standing or on the ground in this stand, even though many of these trees were shaded out by the developing Douglas-fir understory 60 to 80 years ago. From recent stand data collection, it appears that about 120 years ago this part of the Middle Fork landscape was an open savanna of scattered Douglas-fir, ponderosa pine and Oregon white oak with tree densities ranging from just a few to 15 trees per acre, with a more or less dense grass understory.

Oregon white oaks are still present on these slopes, but they are more or less restricted to the margins of the several small, rocky openings which occur throughout the stand. These remaining oaks are occupying the most marginal sites, and few living trees attain the stature that the now dead oak once achieved. The pines still exist in these forests but they are slowly dying either of old age or through chronic root competition from the dense Douglas-fir understory. There is no pine regeneration, other than within the 63 acres of young stands created by past regeneration harvesting, as pine seedlings do not grow well in the shade of a closed canopy forest, and pine seeds need a bare soil seed bed to germinate well.

Most of the Jim's Creek stand, as delineated on the attached map, would probably be most correctly classified as a special plant habitat, as at one time it was closer to a meadow than the closed canopy coniferous forest it is now. Barring some kind of disturbance that would facilitate the regeneration of ponderosa pine and Oregon white oak, it is likely this forest will soon become a more or less pure, closed canopy stand of Douglas-fir. Considering that the existing Douglas-fir understory appears to be reasonably healthy, this site would likely be a pure Douglas-fir stand without frequent disturbance.

1. Abiotic Site Conditions

Most of the biodiversity concerns and objectives which drive the purpose and need for action in this area are closely related to vegetation and the plant and animal habitat it provides. But the types of vegetation that can occupy a given site is very much determined by the following physical characteristics.

Topography in the Jim's Creek area is variable but can generally be typified as gentle slopes. Slope gradients vary from nearly flat to over 50 percent. The steepest slopes tend to occur near the larger drainages such as Deadhorse Creek. Elevations range from 1920 to 3080 feet above sea level. Slope aspects vary from nearly straight east to straight west but can be typified as southerly.

Soils in the project area (as described by Legard and Meyers, 1971) are somewhat variable but can generally be typified as shallow (two to three feet to relatively unweathered bedrock), somewhat rocky, and fine-textured (clayey), resulting from weathered in place red and green breccias and some andesitic lava flows Landtypes within the project area (as per Legard and Meyers, 1971) include 2, 3, 15, 310U, 316, and 233, but 316, a two to three foot deep gravelly loam, covers nearly three quarters of the area. In some areas the soil is very rocky and shallow;

typically these areas are where the extant meadows occur. Surface soil erosion potential ranges from high to severe (assuming a totally bare soil surface) but water infiltration is high. All soils on the project area are listed as being stable to moderately stable in terms of mass movement. There are many indications of shallow surface soil movement across the project are, as evidenced by soil lobes at the leading edge of the flow. None of the trees growing on these slump features have a form that would indicate this surface soil movement has occurred within the life of those trees, which may be as old as 400 years.

Climate in the project area can be typified as Mediterranean or maritime influenced. Winters are relatively warm and wet, summers are warm to hot and relatively dry in terms of both precipitation and relative humidity. The Jim's Creek area is in the rain shadow of the Calapooya Mountains to the west and as such is somewhat drier than adjacent areas such as Oakridge and considerably drier than higher elevation areas along the Pacific Crest. Rainfall averages are not available for the Jim's Creek area, but a relatively nearby weather station in the vicinity of Emigrant Butte indicates the average precipitation in the Jim's Creek area is likely not much greater than 36 inches per year.

Weather at Jim's Creek is quite variable but can generally be typified as warm and dry. Snow does fall in the area but rarely accumulates as a snow pack. Most snow that falls is mostly gone in a day or two. Winter rains are generally gentle and can last for days. There can be very occasional summer thunderstorms which can deposit a considerable amount of rain in a very short time, but there are probably more dry lightning storms in the area which may have contributed to the development of the once more open forest. Summers are typically hot and dry; little precipitation, other than the infrequent thunder storms mentioned above, falls in the area between June and November.

Hydrology: the project area is entirely within the transient snow zone, that area where snowpacks, if they accumulate, do not persist due to subsequent rain events. The project area contains eight unnamed class IV (intermittent or ephemeral) streams. The largest stream in the project area, Jim's Creek, does not have year-around flow over its entire length but there are a few limited sections where subterranean flow surfaces during late summer at bedrock exposures. Deadhorse Creek, a class II (fish bearing) stream forms the eastern boundary of the project area. The project's southern boundary is on the Class I main stem Middle Fork of the Willamette River. As mentioned above, the soils in the area all have a high infiltration rate.

2. Current Vegetation Conditions

Stand Structure

The forest in this area is somewhat variable in species composition, tree spacing, average diameter, and the spacing of the older trees, but the area is not so variable that it cannot be generally characterized as a 156 tree per acre closed canopy forest of 100 to 130 year old Douglas-fir. The average basal area occupied by tree stems is about 250 square feet per acre and ranges from 120 to 480 sq. ft. This forest also contains a scattered, emergent overstory of Douglas-fir and ponderosa pine with diameters from 36 to 68 inches. These older remnants of the previous stand condition average about 4.4 trees per acre at this time. The diameters of the 100 year old cohort of trees range from less than 8 inches to as large as 36 inches, averaging about 15 inches. This wide spread in diameters in this age class indicates the area seeded in with mostly

Douglas-fir and some ponderosa pine over a period of time. Some trees appear to have become established before others and then were free to grow with little competition so as to achieve an early and rapid diameter growth rate. This originally open-grown condition is evidenced not only by the large diameter of the residual trees, but also by largr, persistent dead branches lower on these larger tree stems, indicating the trees grew with ample room for crown expansion. These are the trees which likely would have survived the next underburn, had it occurred.

Current Stand Composition – on 505 acres (not counting managed plantations)

Species	*Trees per acre*	*Basal area/acre*	*Gross vol./acre - MBF*
Douglas-fir	130	181	45.3
Ponderosa pine	8	33	10.8
Incense cedar	15	25	4.5
Sugar pine/grand fir	4	4	1.1
TOTAL	157*	243	61.7

Diameter class	Trees per acre
8-12”	78
14-18”	44
20-24”	21
26-30”	8
32-36”	3
38-42’’	2
44-48”	3
>48”	1
TOTAL	160*

* These numbers do not match due to rounding.

Crown depths range from 25% to 35% of the total height of the 100 year old cohort and 30 to 50% for the remnant savanna trees. Crown closure ranges from 60 to 85% (excluding meadows and small forest openings that likely were meadows 50 or more years ago).

Stand Volume and Health

The existing forest contains on average, about 50,000 board feet per acre, net, of merchantable timber volume, and a total wood volume of about 62,000 board feet per acre. By and large these stands are relatively free of defect such as fungal decay and stem breakage due to their overall young age. There is a low incidence of the stem rot *Fomes pinii* and a very occasional occurrence of *Phellinus weirii* root rot. Dwarf mistletoes do not seem to be present in the Douglas-fir in these stands but some has been noticed in the older ponderosa pine. No true mistletoe has been noted in the Oregon white oaks, though it is common in oaks occurring in the City of Oakridge.

Ground Vegetation

Shrubby understory vegetation is generally very sparse, consisting primarily of poison oak, tall Oregon grape, ocean spray, and hazelnut. In many places the shrub layer is non-existent.

Herbaceous ground vegetation is also very sparse, consisting primarily of very shaded remnants of the apparently original native bunchgrasses, tarweed, woodland star, bracken fern, Oregon grape, and a number of even more sparsely distributed forest floor forbs.

Meadows

This portion of the landscape still contains a number of small grassy openings and one larger one near the ridgetop. These meadows are typically rocky and thin soiled and become very dry during the summer, but they contain a wide assortment of plants in the spring, including camas, various grass species, and some unusual forbs more typical of areas further to the south. Most of these meadows contain some amount of weedy, non-native annual plants, including some grass species, such as cheat grass, considered to be noxious. Since this entire areas was grazed into the early part of the 20th century, these weedy species were probably brought in by livestock.

There are about 15 of these small meadows that are ¼ to one acre in size, and the larger one, which contains some clumps and islands of mature trees, covers about 15 acres. Most of these meadows still contain some live white oak within them or on the edges, but with a few exceptions, these oak tend to be smaller than those which once existed in the areas between the meadows. The smaller, marginal oaks do not seem to produce much in the way of a seed crop. Several large, open grown, more vigorous oak in these meadows have been observed to bear a significant number of acorns in the falls of 2001 and 2004.

Plantations

As shown on the following map, the Jim's Creek stand contains four plantations created by past regeneration harvest, totaling 63 acres. These harvest units consist of two shelterwood stands and two clearcuts which were completed about 20 years ago and now contain trees from eight to 35 feet tall. All these stands are more or less fully stocked with conifers, though they do not comprise a closed canopy forest yet. It is estimated these young stands will close canopy within the next 15 to 25 years, at which time the understory vegetation will come to resemble that which occurs now under the 100 year old Douglas-fir stand discussed above.

The two areas which were clearcut now support a stand composed primarily of ponderosa pine and somewhat more than two clumps of Oregon white oak per acre. The shelterwood overstories contain primarily Douglas-fir, with some ponderosa pine, incense cedar, and sugar pine, and the young stands below the overstory reflects the species in the shelterwood. These young stands also contain small numbers of Oregon white oak. The young Oregon white oak in all these plantations regenerated after harvest, some from stump or root sprouts, some apparently from seed. All these young managed stands have developed a grassy understory vegetation, though the grass layer is denser in the clearcut stands. The grass consists mostly of California fescue, a native grass that appears to have been common on this landscape before the open stands closed canopy. The shelterwood stands have a more diverse shrub layer than do the clearcut plantations, consisting primarily of ocean spray, hazelnut, Pacific madrone, and deer brush

None of these past harvest treatments included burning of logging slash, so these stands have some amount of medium sized fuels on the ground. This lack of fuels reduction could be part of the reason the small amount of residual California fescue which likely existed pre-harvest was able to survive the harvest and expand to its current 30 to 80 percent coverage, although other plantations in the vicinity of the Jim's Creek project area have been observed to contain considerable bunchgrass cover, though they were broadcast burned after they were harvested.

Plant Associations

The forested plant associations (see USDA/USDI, 2003) occurring in this area are not especially varied, consisting primarily of Douglas-fir/poison oak (CDC124) and Douglas-fir/oceanspray/grass (CDS212) with some Douglas-fir/oceanspray –dwarf Oregon grape (ecotype (CDS211) in the few more moist areas. These plant associations are the driest in the Douglas-fir climax series and typically occur on fine-textured to rocky clay soils. The vegetation in upland areas, excluding meadows, is more or less uniform and is probably best represented as a transition between the first two associations listed above. A more mesic plant association also occurs on the lower east facing slopes above Deadhorse Creek, the Grand fir/dwarf Oregon grape type (ecotype CWS5 22). This association typically occurs on steep slopes with deep clay soils and indicates a relatively dry environment, though it is more lush than the above Douglas-fir associations. The many small and large meadow openings in this area are somewhat more varied than the forest types, but can be generally typified by the Common vetch–peregrine fleabane–blue wildrye non-forested plant association (ecotype FM30 11) or the flat, xeric Rock Garden (Ecotype NRR9 11) (see Hemstrom, et. al, 1987). These floristically very diverse vegetation types typically occur on flat to very steep, shallow-soiled south-facing slopes.

Snags, Down Wood, and Fuel loading

These stands have relatively few snags, and most are of small diameter (2 to 16 inches) from suppression mortality in the 100 year old cohort. There are about 13 snags per acre with diameters ranging from 8 to 16 inches. There are fewer than 0.5 snags per acre over 30 inches in diameter. Most of the large snags are ponderosa pine which have died relatively recently, either from old age or from chronic root competition by the 100 year old understory. While over half the original five large ponderosa pine per acre have succumbed to mortality in the last 100 years, most of these trees, save for the most recently dead, have already fallen to the forest floor since pine wood rots quite quickly. The stand also contains, in many areas, large standing or down dead Oregon white oak stems from a foot to nearly four feet in diameter. Most of these dead oak still possess large limbs indicating their open-grown condition 100 years ago.

Ground fuels are even more sparse than the vegetation; in places there is virtually no vascular vegetation; the forest floor consists primarily of a thin layer of duff and litter. Some of the denser stands of the 100 year old cohort have several small Douglas-fir stems per acre on the ground from suppression mortality. There are occasional large trees on the ground from relatively past mortality of the large overstory pine, as many as two trees per acre in some places.

Most of the forest in the Jim's Creek project are can be typified as Fuel Model 8 (see the Fire and Fuels Report in the project's Analysis File). This type of fuel accumulation generally provides for slow burning ground fires with low flame lengths, with occasional "jack pots" of heavier fuel accumulations. In this fuel model, there is a risk of stand replacement fire only under severe weather conditions.

3. **Past Stand Conditions**

Stand Structure

Prior to development of the 100 year old cohort of Douglas-fir, these slopes had an open, savanna type forest with an average of about 14 large trees per acre scattered variably across the landscape. There were areas possibly up to an acre which are not today associated with a meadow that appear to have been free of trees 100 years ago. A total of 27% of the retrospective plots (see Data Collection discussion below) contained no large trees which existed 100 years ago. Nearly 65% of those "empty" plots were adjacent to another empty plot, implying there may have been areas much larger than $1/10^{th}$ acre with no large savanna trees, but caution should be used in interpreting these data, as the plots were located on a five chain by seven chain grid (330' x 462'; each plot represents 3.5 acres of the project area), and adjacent empty plots do not in any way imply that there were no large tree in the large intervening area between plots. The highest individual plot savanna tree density measured during data collection was 60 per acre, but considering the size of the plots used to collect retrospective stand, it is doubtful that there was any single acre that actually had a full 60 trees upon it. This indicates the variable and/or-clumpy distribution of savanna-grown trees. The tree species distribution in this savanna was as shown in the table below:

Stand Composition 100 years ago – on 505 acres

Species	*Trees per acre*
Douglas-fir	5.1
Ponderosa pine	4.9
Oregon white oak	2.5
Incense cedar	1.0
Sugar pine	0.2
TOTAL	13.8

Judging from the extent of large dead braches on the lower stems of the legacy conifers, crown depth before the 100 year old cohort developed was probably in excess of 60% of total tree heights. For oak trees, crown depth was probably approaching 90% and judging from the heavy lateral braches on the few still living and the many dead and down trres, the oaks were all more or less open-grown. Crown closure in the original savanna was likely quite variable, ranging from nearly zero where there were few trees to as high as 50 or 60 percent.

When the stand exam plots (see Data Collection section below) are stratified to include only the contiguous areas where live, dead or down oak trees greater than 10 inches in diameter were found, the species distribution was a bit different, as shown in the table below, and there was an average of nearly four large oak per acre and ponderosa pine was the dominant species. The highest density oak areas occurred in areas that are now closed canopy Douglas-fir forests between the larger extant meadows.

Stand Composition 100 years ago in high oak occurrence area – about 240 acres

Species	*Trees per acre*
Douglas-fir	3.5

Species	*Trees per acre*
Ponderosa pine	4.6
Oregon white oak	3.8
Incense cedar	0.3
Sugar pine	0.3
TOTAL	12.5

Stand Volume

It is not possible to accurately estimate the timber volume these stands once held, since nearly half the trees that originally occupied this area have been dead for decades, but the volume was certainly much lower than the stand contains now. This was a very open forest, so much of the growing space was not occupied by trees, and the trees that did occur were fairly old and fire-scarred, so they may have had a considerable amount of defect. The stand volume, not counting the oaks (which were for the most part of poor form for lumber use), was likely less than 20 thousand board feet per acre.

Since evidence of any smaller trees no longer exists on the site, it is not known to what degree smaller seedlings, saplings, or pole-sized trees might have existed in this stand 150 years ago. Given the fire frequency (see the Fire History discussion in the next section), there were likely few small trees. There certainly were some which eventually were able to survive the periodic fires to replace the larger, more fire resistant trees as they succumbed to old age, windthrow, diseases or insects, and the occasional locally extreme fire.

Ground Vegetation

It can be surmised that this savanna-like forest contained or more or less dense understory of bunchgrasses. Sparse remnants of a native bunchgrass, *Festuca californicum*, still exist under the younger canopy. This grass is known to thrive in open forest conditions, and this is also the grass that has responded strongly to the increased sunlight provided by the 63 acres of plantations within the Jim's Creek area. The presence of this grass can also be surmised by the presence of phytoliths in the soil (Kirchholtes, 2006) and the frequent nature of the fire (see the Fire History discussion below) which was instrumental in creating and maintaining this open forest. Only grass can provide a fuel bed that can burn frequently but with a low intensity.

It can also be surmised that there was little shrubby vegetation in this savanna. The frequent fires would have periodically killed above-ground portions of shrubby species and would generally favor the growth of grasses and other herbaceous vegetation. Shrub species certainly occurred on these sites but at very low levels compared to open areas in current times. It would be likely that camas (*Camas quamash*) was more common in the open forested grassland than it is on the site now. Camas occurs now in some of the existing meadows. This plant is typically most common in moist or mesic meadow environments and it responds vigorously to burning (Agee, 1996). The areas that are now closed-canopy forest tend to have deeper soils than the still extant meadows, and with few deeply rooted trees on the site, overall soil moisture was probably higher in the summer than it typically is now.

Meadows

The meadows that exist now probably did not stand out much 100 years ago since the surrounding forest was so much less dense. The meadows probably had about the same vegetation as they have now, but were larger since young tree encroachment has not begun. It is likely that the meadow vegetation was more dense and lush since there were many fewer conifer trees around the meadows removing soil moisture from the site.

Plant Associations

Plant Associations are determined both by the qualities and characteristics of the site environment in question, and the disturbance regime that the vegetation is subject to. As discussed below under Fire History, the disturbance regime under which the original savanna vegetation type developed has not existed for the last 100 or more years. The Willamette National Forest Plant Asscoacition and Management Guide (Hemstrom, et al, 1987) does not contain any classification that would unambiguously describe the characteristics of the savanna vegetation type, since this type no longer existed in any clear sense when that classification was developed. That being said, the general vegetation was likely similar to its current classification of primarily Douglas-fir/oceanspray/grass (ecotype CDS2 12) within some Douglas-fir/oceanspray –dwarf Oregon grape (ecotype (CDS211). The tree and shrub species that existed on these sites now were likely the same as those which existing 100 years ago, but they occurred at a much lower density. The ground vegetation was likely very different, however, as the understory was probably dominated by California fescue bunchgrass, a very competitive understory plant that would have very much influenced the amount of cover of many of the herbaceous species mentioned under the above forested plant associations.

The many meadow openings in this area were probably still fairly representative of the current Common vetch–peregrine fleabane–blue wildrye non-forested plant association (ecotype FM30 11) or the flat, xeric Rock Garden (Ecotype NRR9 11), though as mentioned above, they may have been even more floristically diverse and contained more biomass due to a greater amount of soil moisture.

Snags, Down Wood, and Fuel Loading

Given the apparent frequency of past fire, as discussed below, it is unlikely this stand had much in the way of these structural elements. Even though the savanna trees were likely quite large when they died, such a frequent fire regime would have relatively quickly consumed the dead and down trees as they began to deteriorate. Additionally, dead trees on a relatively open southerly slope may very well deteriorate more quickly as exposure to full sunlight and extreme temperature fluctuations tend to make wood crack and break apart more than if it is moist all the time. And lack of moisture would mean the dead stems would be more available to burn when fires came through. Ponderosa pine in particular can deteriorate quickly, as its wood (at least in comparison to Douglas-fir) is quite susceptible to fungal invasion, especially if the bark stays on the tree for a few years after death to keep the wood moist. The fuel model would have been best typified by a more or less contiguous cover of dense bunchgrass.

Most of the forest in the Jim’s Creek project 100 years ago could probably be typified as Fuel Model 2 (see the Fire and Fuels Report in the project’s Analysis File). This type of fuel accumulation generally consists of dense grasses and forbs with very little woody material at all, other than occasional, recently dead trees. It provided for moderately fast burning ground fires with low flame lengths that would cause very little vegetative mortality other than for small conifers (under several inches in diameter) and shrubs. In this fuel model, there is virtually no risk of stand replacement fire under any conditions.

E. Fire History and How it Maintained Savanna Conditions

In the past, occasional low ground fires in the Jim's Creek project area, as well as within the larger mixed conifer forest type, kept the understory open and grassy and limited the number of trees that could successfully become established. This past stand condition is evident from historical accounts, the structure of these stands, the presence of multiple fire scars on the older ponderosa pine, and bark char persisting on the Douglas-firs' bark. The trees on which fire scars were sampled (see Data Collection section below) each had from 8 to 12 distinctly callused, though small, fire scars, and the average number of visible scars per tree was 9.6. The interval between scars ranged from 2 to 18 years and averaged 6.4 years. Interestingly, even though these trees occurred on essentially the same slope, there was no consistent pattern in the number of years between scars from one tree to the next. All the scars tallied occur within 150 years or less of the last fire event on this landscape. This implies that the fires were even more frequent than the above numbers suggest, since apparently not every tree was scarred by a given event, and probably less than 25 percent of the remaining pine have any scars at all, further suggesting low intensity fires. The advent of fire suppression and lack of managed underburning has resulted in the development of a dense 100 to 120 year old secondary canopy of Douglas-fir, and in some places incense cedar.

Evidence exists implying this area may have been created or at least maintained by intentional burning by Native Americans. While there are no references to native use of fire in this specific area, such use is well documented throughout the Willamette Valley (Agee, 1996; Boyd, 1999). There are abundant prehistoric cultural remains within and adjacent to the project area, indicating people have been using this area heavily for perhaps thousands of years (Winkler, 1984; Winkler and Bailey, 2002), and the presence of culturally modified ponderosa pine show this use continued into relatively recent times. There are numerous examples of what have been called "medicine trees" scattered throughout the stand. These are ponderosa pine which at one time had about 25 percent of their cambial surface exposed from removal of the trees' bark 2 to 8 feet above the ground. Though many of the extant resulting scars have been charred by the last fire to burn in this area, they typically do not occur on the uphill side of the trees stem as do most fires scars. Additionally, these scars do not extend down to the soil and are not triangular in shape like most fire scars tend to be. A few of these scars also have some tools marks in the exposed wood, and some of these have been charred by fire after they were made.

We can speculate as to why this intentional burning might have taken place. We know the original inhabitants of this area utilized ponderosa pine in historic times for poorly understood reasons. It can be assumed that these people valued the pine and understood that other conifers could eventually take over the site. Additionally, the open forest environment provided habitat for other important food organisms, both plant and animal. While there is no evidence that people in this area utilized oak mast (in the form of stone artifacts that could be used for processing acorns), there may have been use made of the oak in this area as well.

A study of the fire history in the Warner Mountain area about two miles north of the Jim's Creek area (Kertis, 2000) generated a fire return interval of from 26 to 42 years. A fire regime this infrequent would not likely provide for the persistence of a savanna structured vegetation type since it is apparent from the structure and density of young forests in this area that it takes less than 25 years for a pine forest to develop a closed canopy. Plantations in the area which have not been subjected to periodic fire have, by the time they are 20 to 25 years old, effectively suppressed the native grass understory. It is the grass fuel bed that drives the light underburning regime that would maintain these open forests. In that length of time trees can become large enough to survive the fires that would burn in a closed forest environment.

It is assumed the difference between the fire return intervals in the Warner Mountain area versus the Jim's Creek area is explained as the difference between the natural periodicity of lightning fires versus the additional frequency caused by intentional burning by aboriginal peoples. The frequency of burning needed to maintain this savanna is likely greater than historic natural fire starts in the area.

A fire regime and condition class delineation was recently completed for the entire western Cascade mountains, including the Willamette National Forest, to identify locations where fire regimes are outside their natural range as a result of historic fire suppression activities (USDA, et. al., 2005). A Condition Class 3 indicates that many historic fire cycles have been missed, while a Condition Class 1 indicates the fire regime is still within its natural range of occurrence. This delineation was based upon plant association groups and assumptions made about fire regimes in each groups. Such assumptions are necessarily broad; the Jim's Creek area has been mapped as having a Fire Regime II (a 0-35 year fire frequency with high severity fire, resulting in more than 75 percent stand replacement). Conditions on the ground indicate the area's fire regime would be more accurately typified as Fire Regime I (see the discussion above regarding fire scar counts). Notwithstanding this erroneous fire regime typing, the Jim's Creek area and the surrounding mixed conifer forest type occurring on southerly slopes were classified as Condition Class 3, with the exception of the 20 year old plantations within the project area (see the condition class map contained in the project's Fuels Report) which were typed as Condition Class 1. Given that these plantations were never burned and that they contain young stands of trees denser than forests of any age on these sites used to be, these areas would be more correctly typed as being in Condition Class 3 as well.

The fires that maintained this savanna type must have been of fairly low intensity to allow the perpetuation of Oregon white oak, to have scarred only a percentage of the ponderosa pine, and to have formed the many small fires scars seen on individual trees, and they must have been relatively frequent to be of low intensity. Given the extensive evidence of Native American use of the area and accounts that the original inhabitants of this landscape did use fire to modify their environment, it seems evident that intentional aboriginal burning was instrumental in maintaining this open forest. This forest could have originally developed during a drier climate regime with more frequent natural fires, or Native American burning could have gradually created it from an originally more dense stand.

The structure of the current forest looks, on the surface, like many other relatively younger stands created by a stand replacement fire which contain scattered, individual older residual trees which survived the original fire. This is a fairly common occurrence and stand structure on the Middle Fork District and typically the stand replacement fires burned in a more or less closed canopy, mature forest. The main characteristics of the Jim's Creek forest that shows us it developed differently are the lack of remnant structure from trees which did not survive the stand replacement fire; the heavy (though now dead) lower branches on the remnant savanna legacy trees and the presence of numerous, obviously open-grown Oregon white oaks, both live and dead. A stand that developed after a stand replacement fire in a closed canopy forest would have numerous down trees or standing snags with signs of a charred exterior, or, in the case of a reburn some time after the first fire, there would be numerous charred tree stubs (since the bulk of a dead tree would be consumed by the second fire). This type of residual forest structure is generally not found in the Jim's Creek area. The presence and form of the many scattered, dead and down Oregon white oak show this stand was not a closed canopy conifer stand 100 years ago, since those oaks would not have persisted in a closed canopy stand dominated by taller conifers, or at least they would not have a spreading crown form. So the residual structure of the Jim's Creek forest shows it is not the typical "fire stand" that can be found throughout the southern half of the Willamette National Forest.

F. Discussion and Management Implications – Stand Diagnosis

The overall appearance of this stand indicates in a general way that stand structure and species occurrences have changed significantly in the last 100 years. The data collected allows me to roughly quantify the magnitude of that change, at least in terms of the number of mature trees this site supported over time. Considering the number and species of trees that existed on this site about 100 to 120 years ago, the number of fire-scarred trees, and the complexity of those scars, this stand has experienced repeated fires over the life of the oldest trees on the site. This fire regime had a fundamental influence on the vegetation structure and species occurring on this portion of the landscape. Once this frequent fire regime ended, which appeared to have occurred 120 to 130 years ago, these slopes more or less rapidly became forested with a closed canopy stand of primarily Douglas-fir. The current health of this stand indicates that most of this site is capable of supporting a closed canopy forest, indicating the previous open, savanna-like condition was dependant upon frequent, low intensity ground fire. The assumption that these fires were of low intensity can be made based upon the small size of the fire scars, the fact that many of the older trees do not have any obvious fire scars, the frequency of these fires as evidenced by the fire scar record, and the fact that relatively thin-barked oaks were able to survive in a landscape with periodic fire.

The 1996 wildfire underburn which occurred in the northern corner of the Jim's Creek stand (above road 2129.371) shows us that a simple re-introduction of fire would not be able to accomplish the objective of returning these forests to a more open condition. This fire, in most places, typically did not kill even the smallest of the 100 year old cohort of Douglas-fir, and within the small patches of full mortality that did occur, trees of all sizes were killed, including the large diameter, thick barked pine that had survived several fires in the past. If it is desirable to return this stand to its previous condition, some treatment which would facilitate the development of a more or less grassy ground cover would have to be implemented. A grass understory would provide the light and flammable fuels to carry a fire and keep conifer seedlings and saplings and various brush species at low levels, while not having enough heat energy to kill mature trees.

If we want to re-establish the more open condition of the past, retain the legacy trees, and create a dense grass understory in order to respond to the above discussed biodiversity objectives and the fact that the vegetation type that used to be on these sites is now very rare, about 140 to 150 trees per acre of the 100 year old cohort which have come into this stand with the cessation of frequent fire would have to be removed in some way. Some of these younger trees, ideally the larger of them, would need to be left to replace the legacy trees that have already died, as well as ones that will continue to die in the coming decades. A number of these larger and older trees have already died in the last 50 years due possibly to root competition with the dense understory Douglas-fir, and due to the fact that they are all fairly old and nearing the end of their lifespan, especially ponderosa pine which typically does not live quite as long as Douglas-fir. Based upon the development of the young stands within the four plantations created by past clearcut harvest, opening up this forest should provide for reestablishment of a grassy understory and oak saplings without any specific management activities. This successful reestablishment may have been due to the fact these stands do still contain a sparse remnant of these grasses which will respond to increased sunlight. Any management activities contemplated in this area seeking to redevelop this grassy understory should strive to avoid any type of disturbance which could be detrimental to the initial survival of the sparse existing grass cover, but conscious actions to re-establish this grass layer should be taken in the case that the hoped for response from the remnant grass does not occur.

Given the Desired Future Condition as expressed in the EA, there is also a need to assure that the existing, management created plantations in the project area be folded into the savanna restoration. The desired future condition is that at some time in the future, these "plantations" will look no different than the surrounding restored savanna. It is therefore desired and necessary to apply several treatment to these four plantations. The young trees established after harvest should be thinned out drastically to provide for vigorous ground vegetation and height growth and crown development of white oak. The grass should be periodically burned to promote its vigor and reduce the incidence of conifer seedlings and brush. The shelterwood overstories should remain more or less in their current condition to provide for a variation in tree spacing across the landscape (these stands currently contain more than the prescribed average number of retained mature trees) but there may be a need to create snags from some of these trees in the future if natural mortality does not do so.

G. <u>Data Collection Methods</u>

Data on existing forest conditions in the unmanaged forested stands were collected from a total of 105 variable radius plots using a 40 BAF prism. These plots were systematically located, using east/west transects established with a spacing of 7 chains (462 feet). Plots were taken along these transects every five chains (330 feet)   These 105 plots covered about 575 acres which results in a sampling intensity of about one plot for each five acres. An additional 20 plots similar to those described above were taken in the 47 acres of shelterwood plantations which occur in this planning area (stands #2810 and 2696). In all these plots, trees greater than 8 inches in diameter were tallied by species and two inch diameter class up to 62 inches. A few trees larger than this were encountered; these were included in the 62 inch class for analysis purposes. Data from these plots were inserted into a locally generated spread sheet to calculate trees per acre by diameter class, basal area, and a total volume by diameter class and species. An average form class based upon average height of the dominant and co-dominant trees was used in the volume calculations. Tree heights were periodically collected on a random basis. Tree heights for the older, emergent canopy trees range from 150 to 190 feet. Heights of the 100 year old cohort range from 77 to 147 feet and averaged 121 feet.

Data to estimate past forest conditions were collected using 105 1/10th acre plots (radius of 37.23 feet) with the same centers as the above variable radius plots; none were taken in the shelterwood plots, since those forests have been too disturbed by harvest to accurately assess which dead and down trees might have been alive 100 years ago. The intent of this fixed radius sampling was to give an indication of what kind and number of trees were on this site about 100 years ago, before the existing 100 year old cohort dominated the site. All trees, regardless of condition, which were thought to have been alive about 100 years ago were recorded by species and 2 inch diameter class. In some cases diameters were estimated if the tree bole was especially deteriorated, or bark and or sapwood were no longer present, but generally only trees which had a more or less intact bole that had not been charred by long ago fires were counted. Very few dead and down tree stems that exhibited char from past fires (not counting ponderosa pine with conventional fire scars) were encountered. It was assumed that a well deteriorated, charred tree was dead before the last fire burned in the area, and was not part of the living stand at the time the younger cohort began. Trees per acre by species were hand calculated for these fixed-radius plots. This data collection was used only to estimate the number of mature, dominant trees on the site which would have been large enough to survive periodic ground fires. Small trees which may have existed prior to fire suppression would have left very little evidence of their presence and there was no attempt to tally very subtle indications of past presence ofsmall trees.

Tree ages were collected in a random fashion during the collection of plot data. Most cored trees were in the younger cohort as most of the older trees were too large to accurately age with available increment corers. Several stumps were aged in the four harvest units, and one fallen tree was sectioned with a chain saw. The younger, secondary canopy age class range in age from 90 to 120 years at breast height. The older, larger tree ages range from 239 to 380 years at stump height.

Fire scar counts:

To get a general idea of how frequently fire occurred on these slopes in pre-fire suppression times, five ponderosa pine with basal fire scars were sampled across the south-facing slope below road 371 and west of Jim’s Creek. This sampling was done to determine whether these charred scar faces contained repeated scarring by low ground fires and to determine the interval between such scars, if they existed. The sampled scars were all classic fire scars; triangular in shape, extending to the ground surface, with extensive charred wood interior to the live callus tissue, and most were concave or flat in cross-section. Sampling consisted of light chopping into the charred faced of the scars with a small hatchet to expose unburnt wood so that annual rings between scars could be counted. No attempt was made to absolutely date any given scar, nor to determine the age of the trees sampled (though all tree sampled were legacy trees that likely exceeded 200 years of age). All five sampled trees had multiple fire scars and the amount of radial stem growth after the last scars (though rings were not counted) was commensurate with the last fire occurring more than 100 years ago. Others tree throughout the project area have been more informally examined; most slopes contain at least occasional fire-scarred pine with indications of multiple scarring. From this author’s experience, a flat to concave basal fire scar on pine is only created by multiple fire scarring.

H. Alternatives

This section contains the effects of the Alternatives developed and analyzed during the Jim's Creek Savanna Restoration environmental assessment, focusing on the proposed density reduction of the 100 year old understory trees, as addressed in the EA relating to silvicultural issues, primarily the effects upon the biodiversity issue and evaluation criteria, as presented in Chapter IV of the EA.

1. Alternative Descriptions

The alternatives briefly described below are more fully described in Chapter II of the Jim's Creek EA. All the below alternatives, save No Action, include more or less the same suite of post-harvest restoration activities, as listed at the end of the descriptions. Those relating to silvicultural issues, such as planting, thinning, burning, etc., are addressed in greater detail in the Silvicultural Prescription. These alternatives were all considered in development of the treatment prescriptions that follow. Rationale as to why various alternative treatments were ultimately not selected for implementation is also presented.

Alternative A - Proposed action –This alternative would open up a portion of the forest to provide for reestablishment of the native bunchgrass and provide the potential for natural or managed ponderosa pine and Oregon white oak regeneration. About 241 acres would be treated initially with a single entry understory density reduction. Approximately 90 percent of the younger age class Douglas-fir, grand-fir, and incense cedar would be removed to maintain an average of about 20 trees per acre with a commercial timber sale. Trees would be removed by cable machinery capable of suspending at least one end of the logs above the ground surface where it is feasible to do so from the existing road. In areas where that kind of cable removal is not feasible, helicopters would be used to achieve full suspension of logs.

Primarily the larger of the younger age class of trees would be retained, but all ponderosa pine and sugar pine, regardless of size, (other than those encroaching upon meadows) would be retained, other than as described below. Since the largest trees are not evenly distributed across the landscape, the distribution of retained trees would be variable and there may be some areas up to several acres in size which would have no retained large trees in the areas treated by tree removal. None of the older savanna legacy trees would be removed; no ponderosa pine of any age class would be removed except when they are so close to remnant oak that they pose a significant risk to those oak trees, or where there are only young ponderosa pine, as in areas of meadow encroachment. About 12 of the largest 100 year age class trees would be retained to provide for replacement of savanna trees which have died or for those that will die in the next several decades.

Alternative B – No Action - This alternative does not respond to the Purpose and Need for Action described above. Display of the No Action alternative is required by the National Environmental Policy Act and provides a baseline for estimating the effects of other alternatives (Forest Service Handbook 1909.15 – Environmental Policy and Procedures, Chapter 10, 14.1)

This alternative also would not comply with Forest Wide Standards and Guidelines FW-201 and 211 which respectively direct that biological diversity ***shall*** be maintained or enhanced, and that wildlife and plant habitats ***shall*** be maintained (emphasis added).

Alternative C: - This alternative would begin restoration on a somewhat smaller area than addressed in Alternative A, and would implement a different strategy of treatments. Excess understory trees in the 100 year age class would be removed in two or more stages to address the concern that removal of all excess trees at once might create a problem. This alternative responds to public concerns which have been expressed that rapid restoration of a more open forest conditions could harm the retained trees, possibly by making them more susceptible to windthrow. This alternative would initially retain about 40 trees per acre with the idea that another 10 or so would be removed later to continue the full restoration. The removal of the understory trees described above would be accomplished using a timber sale. Trees would be removed by cable machinery capable of suspending at least one end of the logs above the ground surface where it is feasible to do so from the existing road. In areas where that kind of cable removal is not feasible, helicopters would be used to achieve full suspension of logs. Altogether, understory density reduction would occur on about 171 acres.

Alternative D: This alternative proposes understory density reduction on about the same area as Alternative C, but with differing prescriptions. This alternative responds to the uncertainty some have expressed regarding what type of restoration treatment may be most successful. Is provides three different approaches to making the residual pines and oaks more vigorous, with the idea that with the passage of time it will become apparent which alternative treatment is the most successful, and adaptive management can then be employed to determine which technique should be applied over the entire area. On 65 acres understory trees would be removed to result in an average retention of 5 to 15% of the stand (about 20 trees per acre, similar to the removal prescribed in Alternative A). On another 49 acres, from 20 to 25 % of the stand would be retained (again the largest trees in the stands,) similar to that proposed in Alternative C, with the idea that more trees would be removed in the future if the heavier removal iteration performed well. On about 42 acres (that area containing most of the meadows where most of the larger oaks remain) trees competing with live oaks would be removed (generally within a radius equal to the height of the trees to be released). Trees would be removed by cable machinery capable of suspending at least one end of the logs above the ground surface where it is feasible to do so from the existing road. In areas where that kind of cable removal is not feasible, helicopters would be used to achieve full suspension of logs. Altogether, understory density reduction would occur on a total of about 171 acres.

Alternative E. - This alternative most directly addresses the purpose and need for action and would accomplish restoration of the project area the most quickly, if successful. It is similar in concept to Alternative A except it would remove all the younger age class understory trees excess to the original savanna condition on the approximately 455 acres of the planning area not affected by past harvest, within meadows, or fish-bearing stream riparian reserves.

Activities common to all Action Alternatives:

- abatement of slash generated by the understory removal by hand piling and burning at least to levels prescribed in Forest-Wide standard and guideline FW-252.

- grass seeding of California fescue;
- Oregon white oak planting;
- noxious weed abatement;
- native plant reestablishment (those important to cultural use such as camas, bunchgrass, yampa, etc.);
- existing meadow restoration through removal of encroaching small conifers and reintroduction of fire;
- Closure of roads once cultural activities are completed;
- Snag creation in some retained trees if it is determined that natural leave tree mortality has not occurred or has not generated adequate numbers or qualities of snags;
- underburning in five to ten years, once grass has become established, depending upon the development of the Oregon white oak seedlings, and upon what we learn from the Mutton Meadows tests; see section H. of the Silvicultural Prescription below;
- Further young stand density reduction in the four plantations within the project area, as well as applications of prescribed underburning,
- Clumped green tree retention would occur north of the ridge that divides this area from the Young' Creek drainage, and south of road 2129.

2. Alternatives Considered But Not Fully Developed and Analyzed:

The following alternatives were at some time discussed during the development of this restoration proposal. Several of these general strategies were suggested by members of the public early in the development of the project. They were determined to not warrant further development and analysis due to either economic or physical feasibility problems, the fact they intuitively or obviously do not respond very well to the purpose and need for action, or they would involve excessive resource risk and/or were likely be unacceptable to the general public. This report will expand upon the reasons these alternatives do not need to be seriously considered as viable silvicultural options.

Alternative prescriptions designed to restore the originally more open stand conditions would vary primarily by the number of trees retained on site. As the number of trees proposed for retention increases, at some point the restoration objectives are compromised somewhat or considerably. The number of trees proposed for retention as discussed above is based on the original number of mature savanna trees with a few additional trees per acre retained to provide for continuing loss of larger trees as their life span comes to an end, and to allow safe provision of snag habitat. Retention of less than this number of trees per acre would not make sense, since we would not be restoring the area to its original condition. Retention of considerably more trees per acre would compromise the regeneration of oak and pine in favor of Douglas-fir, would not provide for the vigorous re-establishment of the native bunchgrass and other forbs, and would also be inconsistent with savanna restoration and habitat provision objectives.

Restoration by Underburning: This alternative avoids the need to fell and or remove trees by relying upon prescribed fire to thin the 100 year age class of Douglas-fir that has encroached upon the one-time savanna. Initially this alternative may appear to be very intuitive; after all, the cessation of prescribed burning by the Native Americans and the commencement of fire suppression has caused the virtual disappearance of the original savanna. Upon reflection and observations of the effects past underburning has had in these types of forests, it becomes quite obvious that underburning alone cannot achieve the restoration of savanna conditions in this now closed canopy forest of fire resistant trees. The frequent, low-intensity fires that maintained the original savanna vegetation and allowed for the persistence of the relatively thin-barked Oregon white oak were burning in a fuel bed very different than what exists today on these sites. The prescribed fires of the Native Americans could not have generally killed older, thick barked trees as those fires were burning in grasses and had relatively short flame lengths and residence times; they merely prevented young, fire-susceptible tree seedlings from becoming large enough to become fire-resistant. It is not realistic to expect fire burning in an entirely different fuel regime to have the same function as one burning under an open stand of tees with a grassy ground cover.

Fortunately, there is a very good, recent example that clearly illustrates why this alternative cannot accomplish the purpose and need for restoration. In August of 1996 a wildfire burned about 60 acres of the landscape that eventually became included in the Jim's Creek Savanna Restoration project (in the northern corner of the project area, above road 371). This fire was one of many that were started by a large lightning storm on the Middle Fork Ranger District. This particular fire was allowed to burn for three days without fire suppression activities because resources were is short supply and it was recognized that the low fuel loading in the general area meant there was a low risk of this fire doing wide-spread damage. The results of this fire are still obvious on the ground today. It was, for the most part, an underburn; less than ten percent of the trees were killed by the fire and those typically in small patches where the fire killed both young and older trees. This patch mortality was likely due to a greater than average amount of fuel accumulation in localized areas, or the presence of a patch of ladder fuels.

In the bulk of the area that underburned, no or only the smallest trees were killed. The amount of canopy closure was essentially unchanged by the fire, so there was little benefit from it in terms of restoring the original ground vegetation. There is still insufficient light falling on the forest floor to provide for successful bunchgrass reestablishment or regeneration of ponderosa pine and Oregon white oak. For a long-term restoration perspective, repeated application of fire similar in magnitude to the 1996 event would likely continue to be unsuccessful in further restoration of this area; the trees that did not get killed by the first fire would be larger in diameter and have thicker bark than they had during the first fire, even the smallest of them, and there would be little fuel available to carry a fire of any magnitude (other than a running crown fire). We, therefore, would expect even less effect from frequent, subsequent burns.

Considering that it is very unlikely we would consider applying prescribed fire to this piece of ground in mid-summer, it is logical to assume that prescribed fires would have even less efficacy for restoring a more open forest type than did the 1996 wildfire, since they would likely be prescribed to occur under less risky scenarios in terms of fuel moisture, relative humidity, and wind, so flames would be shorter in length and duration than they were in August of 1996. Additionally, such prescribed underburning may be inimical to the objective of re-establishing the native bunchgrass. It has been noticed that there is very little to no sparse bunchgrass now existing in the underburned areas. This is of some concern as there are still sparse, remnant, bunchgrass plants scattered throughout the Jim's Creek forest. It could be that the underburn stressed the very shaded remnant bunchgrass plants, which then received no benefit of increased sunlight from the fire since few trees were killed. This stress with lack of positive impacts may have actually killed the bunchgrass that had persisted under the forest canopy, rather than put it on a path to restoration as has seemed to have happened in the four managed plantations in the Jim's Creek area.

Notwithstanding the relatively benign effects of the 1996 fire, areas north of the Jim's Creek area containing similarly structured forest also burned during the same fire occurrence and these stands did tend to burn catastrophically (meaning large, contiguous areas of forest were killed). Relying on late-season fire, whether natural or prescribed, to generate restorative benefits without a concurrent re-structuring of the vegetation being burned would always entail a risk of loosing the entire stand, including the legacy trees, the larger trees of the 100 year old cohort needed to replace legacy trees which have died in the last 50 years, as well as the excess 100 year old trees. Even if we could design and prescribe a fire regime that would kill the trees determined to be in excess to what we would want in redeveloping a savanna, the dead tree stems and crowns would eventually become ground fuels. Periodic burning is critical in maintaining a savanna forest and the grass on the forest floor, and has to occur to prevent the area from once again becoming fully occupied with trees. The accumulation of fuels from the deterioration and falling of over 100 fire-killed trees per acre would make application of subsequent prescribed fire essentially impossible without incurring tremendous risk. If only a few trees per acre were killed by prescribed underburning such that fuel accumulations over time was not a large concern, then it is doubtful whether the underburning would have enough restorative effect on the older pine, oak, and remnant bunchgrass before they all die of suppression or old age.

<u>Business as Usual</u>: This alternative was initially conceived to illustrate how the proposed action contrasts with standard forest management in Matrix lands as directed by the Forest Plan, as amended by the Northwest Forest Plan. Essentially, this alternative would entail dispersed regeneration harvest units with green tree retention on blocks less than 60 acres in size in Matrix, and less than 8 to 15 acres in the scenic allocations, with required, relatively dense, reforestation. As such this alternative approach would not meet the purpose and need for savanna restoration. Additionally, it was noted that there is already an example of "business-as-usual" forest management in the project area in the form of the four 15 year old shelterwood cuts and clearcuts, not to mention the numerous examples of that approach to management across the larger mixed conifer forest type surrounding the Jim's Creek project area and within the Middle Fork watershed as a whole. Therefore, there is little utility in fully developing this alternative to savanna restoration as there is no need for creating additional "business-as usual" comparisons, and it would not meet the purpose and need for action.

<u>Restoration by Tree Removal but No Sale of Removed Trees</u>: This alternative would, after full implementation, essentially resemble the Proposed Action in appearance and environmental effects. It would provide for removal of similar amounts of the 100 year age class understory, but that removal would not be accomplished using a timber sale. This alternative would respond positively to the purpose and need for restoration and was originally suggested as a way to achieve restoration while avoiding the potentially controversial sale of trees.

While the environmental impacts of this alternative would be essentially the same as the proposed action, the social and economic impacts would be much greater. The cost of tree removal would not be subsidized by their use for lumber products, hence the felling, yarding, loading, and transportation of the tree stems, and abatement of slash generated by those actions, would have to be born by appropriated wildlife and botanical habitat improvement funding. It is estimated that a full restoration of the Jim's Creek area using this approach would cost in excess of one million dollars, possibly even more, depending upon the degree and methods of tree removal and slash reduction. Additionally, locating an area to deposit and store the tree stems that would have to be removed is problematic. Ultimately, an area capable of holding the contents of over 2000 log trucks would have to be located (for the proposed action; the trees to be removed in alteratnive E would reuire the use of 4000 log truck trips). This area would have to be able to hold a pile of tree stems about 90 feet wide, 50 feet tall and about 1000 feet long. Such a pile of dead wood would create environmental problems of its own, the danger of fire being of greatest concern. This alternative was not fully developed because it is logistically and financially infeasible. Over the last decade, the Willamette National Forest has not received enough appropriated wildlife and botanical habitat improvement funding to implement an alternative such as this as well as continuing conventional habitat improvement projects.

Restoration by Tree Killing but no Removal of Killed Trees: This alternative would remove excess trees in the 100 year age class by killing them, either by girdling or felling. It responds to some of the cost problems presented by the above alternative by avoiding the removal of the excess tree stems. This alternative would partially respond to the purpose and need; the stand density would be reduced such that grass, oak and pine could regenerate, but the prescribed burning that would be needed to maintain the open nature of the forest could not occur without incurring a huge risk of losing all retained trees and re-developing vegetation, as well as creation of detrimental soil conditions, as there would be large amounts of fuel on the ground resulting from implementation of this alternative. Treatment of slash would again be very expensive, and considerably problematic if the tree stems themselves remained on the ground. This alternative would also present a substantial long-term risk for future hot wildfires, considering the amount of large woody material that would be retained on site. It also would create nearly ideal conditions for the development of a Douglas-fir bark beetle outbreak which could potentially kill many of the trees that would be retained. This alternative was not fully considered because its cost would be prohibitive and its implementation would likely create some severe environmental conditions.

Smaller Initial Acreage of Treatment

This approach would be to apply treatments similar to those described in the fully developed Alternatives A, C, or D on a much smaller area, in the neighborhood of 10 to 30 acres. This alternative would respond to the concerns that have been expressed that we really don't know how to do successful restoration of a savanna and the initial treatments to accomplish the purpose and need should be very tentative (see the restoration efficacy discussion below). This strategy was ultimately not considered for full discussion and analysis as it would be somewhat similar to the "Business as Usual" alternative (see above), and more importantly would not be especially effective in accomplishing restoration of landscape savanna conditions. Additionally, small blocks of restoration would not lend themselves to being placed on topographic or other features that would provide for safe and efficient application of prescribed fire. If the prescribed fire could not be applied efficiently in the future, it will likely not be used as frequently as it should to maintain savanna conditions.

The ID Team has determined that there is not as much uncertainty regarding the potential effectiveness of the proposed actions as some people have expressed (see the restoration efficacy discussion below). This greater certainty is evidenced by the successful development of many of the savanna traits and species in the four plantations within the planning area and in other managed stands throughout the mixed conifer forest type. Given these successful examples which show us bunchgrass and Oregon white oak can be reestablished even without supplemental planting, and that retained trees are not especially likely to be blow over or otherwise experience high amounts of mortality, there does not appear to be a need to fully develop such a tentative restoration alternative which would not go very far in accomplishing the purpose and need.

<u>Release of individual oak and/or pine only across the entire area</u>: This alternative was not fully considered because, taken on its own, it would not move the area towards the desired condition of a functional savanna. If only oak were released, there would be no provision for oak or pine regeneration and little provision for bunchgrass reestablishment across the landscape, since there are relatively few oak left on these sites. The effective release of legacy pine and Douglas-fir, which are being impinged upon more from a below-ground standpoint than from shading competition, could result in removal of as many or even more trees than would Alternative E on a given piece of ground, and would not provide for retention of many trees to replace the savanna legacy trees which have or will succumb to mortality. For example, one way to address pine release in terms of below ground competition would be to remove all other trees within the rooting zone. Drier site trees such as ponderosa pine can have roots extending as far as five crown radii from the tree stem (Hall, 1983; Curtis, 1964; Smith, 1964). Assuming a crown radius of 20 feet (they typically range from 10 to 30 feet in this area) one would potentially have to clear a circle 200 feet in diameter to eliminate all direct root competition for an individual tree. This circle would be about 0.7 acres in area. Considering that there are almost two large pine per acre on average in this stand, releasing all pine (if they were evenly distributed) would require the cutting of all other trees. Another convention for fully releasing trees from competition would be a radius of one tree height (Devine and Harrington, 2004), which would result in an ever larger area cleared per tree. Since it is really not practical to release all pine in such a way, and since release of only oaks would not fully address the purpose and need (in that such an action would not address oak or pine regeneration, and would not necessarily provide for overall reestablishment of bunchgrass), this alternative was not fully developed and analyzed.

I. Land Suitability for Timber Production

The National Forest Management Act, as expressed in 36 CFR 219.27(c)(1) requires that no timber harvest occur in land not suited for timber production pursuant to 36 CFR 219.14 unless the harvest is done for reasons other than timber production. The Willamette National Forest Soil Resource Inventory (Legard and Meyers, 1973) delineated such lands and about 115 acres of lands not suitable for tree regeneration within five years exist in the planning area (those being landtypes 3 and 310U). Field reconnaissance has shown that there is not as much of SRI landtypes 3 and 310U on the site as what is mapped in the District's GIS Soils data layer. Since the harvesting that will occur on these "unsuited" landtypes is not for timber production, their suitability for such use is moot.

J. Economics

A Financial Analysis, as per direction contained in Forest Service Handbook 2409.18, Chapter 30, Section 32, has been completed for this project and is contained in the Analysis File. All action alternatives other than Alternative C have a positive revenue/cost ratio and net present value (NPV), though alternatives that treat larger acreages have a larger NPV and alternatives that implement a staged entry have a lower revenue/cost ratio, since less value is removed in the near-term and there is less economic efficiency in those alternatives due to increased mobilization casts and the need to replace vegetation damaged by the second entry. Alternatives A, D, and E can be implemented without incurring costs greater than revenues.

II. Silvicultural Prescription

A. Introduction

It is my recommendation, with concurrence of the overseeing certified silviculturist, that the following set of actions be implemented to best accomplish the purpose and need of restoring this small portion of the mixed conifer forest type to something fairly closely resembling its original savanna-like structure and species abundance and distribution. These actions apply to all stand numbers listed earlier in this report and will result in the creation of a new single stand number for all areas treated, other than the existing meadows. These meadows are in large part a result of significantly different soil conditions and will retain their current stand numbers. This prescription is written for the implementation of Alternative E as displayed in the Jim's Creek Savanna Restoration Project EA. You will notice that Alternative contains several numbered harvest units. The distinction between units was made only to facilitate analysis of environmental effects, specifically to differentiate skyline and helicopter yarded areas. The prescription detailed below applies equally to all harvest units, other than Unit 4 which is a meadow with encroaching young ponderosa pine.

B. Desired Future Condition

The specific desired future silvicultural conditions, upon which implementation monitoring efforts should be based when evaluating project accomplishments about five years after implementation, are as follows:

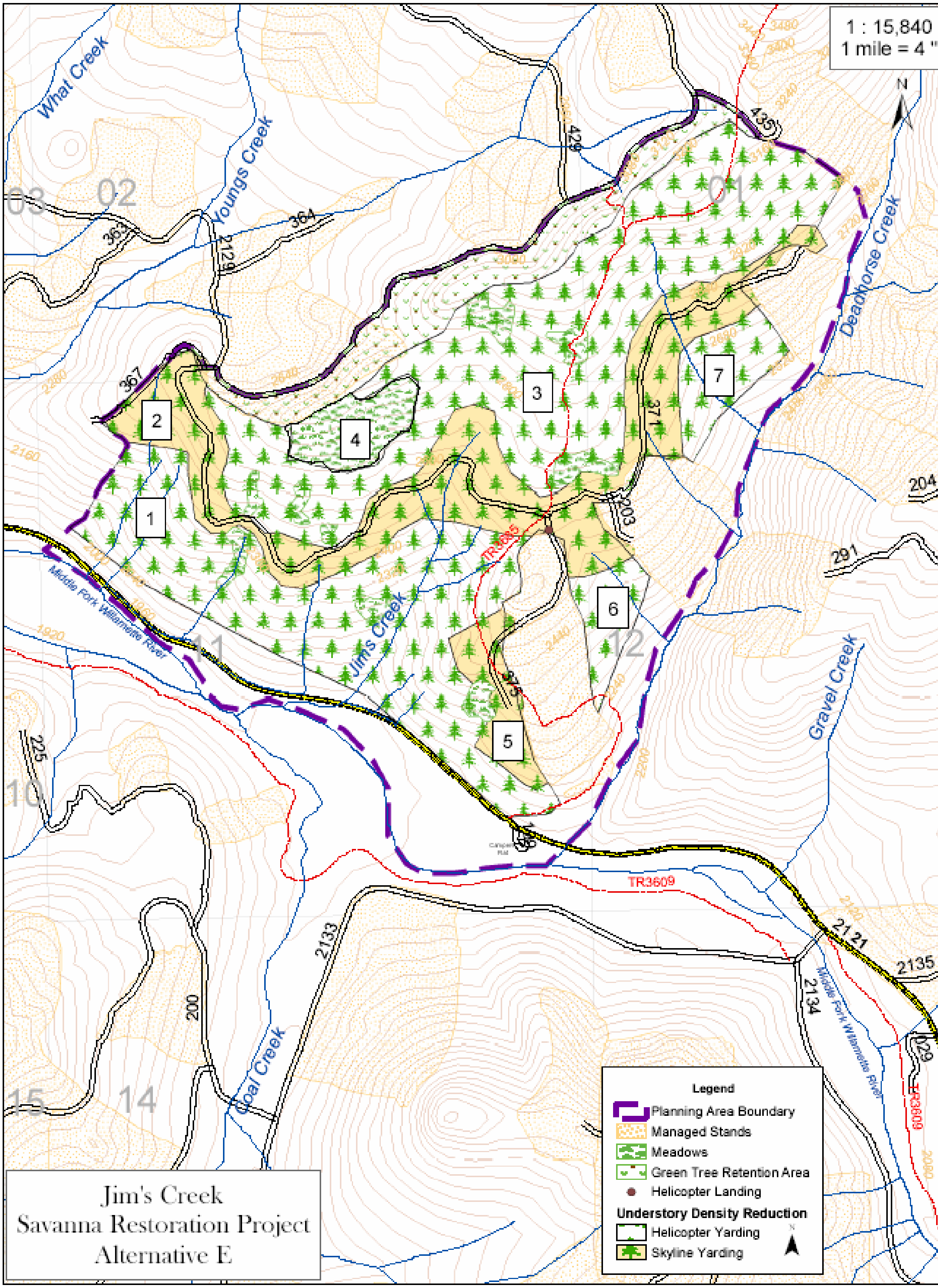
- There should be an average of at least 15 live, mature trees per acre, the largest that exist at this time.
- Retained trees should be distributed randomly across the treatment area, except that all legacy trees should be released from competition from trees in the 100 year cohort,
- There should be no more than about five trees per acre which have either been topped to provide standing dead tree habitat, or which have succumbed to natural morality either through mortality, windthrow, or stem breakage.

- There should be less than 11 tons per acre of slash less than three inches in diameter) generated from excess tree removal remaining on the ground;
- There should be a moderately dense coverage of California fescue developing as the dominant ground vegetation, along with other important native plants such as camas;
- At least four sapling Oregon white oak per acre should exist on at least 60 percent of the treatment area. These oak saplings should be at least 2 feet in height five years after planting;
- Young tree density in the four plantations should be less than 100 and greater than 30 trees per acre. The existing bunchgrass ground cover should be dense and healthy as the result of prescribed burning.
- When all treatments are completed, this area should be in fire regime condition class I (see USDA, et. al., 2005 and the above discussion on fire history)

C. Excess Tree Removal

Tree Removal - As should be apparent from all the above discussion, about 140 excess merchantable trees need to be removed in order to achieve the desired future condition for this landscape and restore this area to its original, more open savanna condition. There has been some confusion as to what silvicultural harvest system this removal should be called. From a residual stocking standpoint, the proposed removal would resembled a traditional shelterwood harvest (see Daniels, et, al, 1979, page 446), except that spacing between retained trees would be very much more variable than a typical shelterwood harvest. However, the retained trees are not being left to provide for an ameliorated seedling environment and would not be removed once seedling become established. Thinning from below could also be used to describe the proposed tree removal, but the degree of removal is much greater than traditional thinnings and there is not an objective (as is common with most prescribed thinnings) to enhance volume growth of residual trees. As mentioned above under Forest Plan compliance, the result of the prescribed excess tree removal is actually uneven-aged management (as per Daniel, et al., 1979 and Smith, 1962). Immediately after completion, this stand will have at least three distinct age classes, and as many as four if the 20 year old trees in the plantations and around the meadows are counted. As the prescribed maintenance burning proceeds, this stand will become increasingly all aged. To avoid confusion, I will continue to refer to the proposed actions and the prescribed silvicultural treatment as excess tree removal, or savanna restoration.

The target retention level is an average of 20 trees per acre, randomly distributed across the landscape. All trees to be removed should be in the 100 year old cohort; all savanna legacy trees should be maintained unless they are dead and present a hazard to excess tree removal or subsequent restoration activities. It should be noted here that there is nothing magic about the desired future condition of 15 TPA. This is simply the average number of mature trees per acre that occupied the site about one hundred years ago. This site certainly held more and less trees per acre on the average at other times since the last climate change. Since our objective is to provide the type of habitat that existed previous to the event of fire suppression, the average number of trees which existed at that time is a reasonable target to shoot for.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1 mile = 4 "
Jim's Creek
Savanna Restoration Project
Alternative E
Legend
Planning Area Boundary
Managed Stands
Meadows
Green Tree Retention Area
Helicopter Landing
Understory Density Reduction
Helicopter Yarding
Skyline Yarding
What Creek
Youngs Creek
Deadhorse Creek
Jims Creek
Gravel Creek
Coal Creek
Middle Fork Willamette River
TR3609
TR3685
1
2
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It should also be noted that all trees less than 24 inches (except as noted below) need to be "removed", even those that are less than seven or eight inches in diameter (those that are not considered "merchantable"). Requiring the cutting of non-merchantable trees generally cannot be included in a conventional timber sale contract, but given that this project will have a stewardship oriented Integrated Timber Resource contract, such service work can be included in that contract. Accordingly, all excess trees greater than two inches in diameter should be felled. Trees smaller than this diameter will likely be killed by the subsequent prescribed burning and do not need to be mechanically killed.

Approximately 20 trees per acre of the 100 year cohort need to be retained to provide for past mortality of the legacy trees and to provide a buffer in the case unexpected mortality of the leave trees occurs. The most likely cause of potential mortality in these trees would be windthrow and/or stem breakage from wind or snow accumulation. I do not expect more than about 2 trees per acre to experience such mortality, based upon the mortality that has occurred over the last 20 years in the two shelterwood harvest units within the planning area. Windthrow potential should be minimal since most of the trees to be retained would be the largest so their form (in terms of their height/diameter ratio) would be such that they would not be inherently unstable, as would a tree with a very slender and tall stem. Additionally, all trees of the 100 year cohort with crowns that touch or are within 5 feet of the crown of a legacy tree should be removed, regardless of diameter. This will result in an average per acre retention somewhat less than 20 TPA, which is more than is needed to provide for continued mortality and snag creation, but as discussed below under snag retention, leaving five more trees than is ultimately desired would be more than adequate to account for future mortality.

Tree Retention - The trees to be retained from the 100 year cohort should be the largest in the stand, other than as described below. Using a diameter limit for tree removal will automatically generate the random distribution and variable spacing between trees that is desired to best mimic the original distribution of legacy trees. In the Jim's Creek stand, removing all trees less than 24 inches in diameter (as excepted below) will result in the retention of about 20 per acre on the average, though retention levels from one acre to the next may vary from none to over 30 per acre. The one exception to this goal relates to the adequate release of all legacy trees in order that they be maintained in as vigorous a condition as possible, as discussed above.

This retention level of more mature trees than the ultimate desired condition is made to provide a hedge against unforeseen mortality, and as a concession to those who are concerned that an immediate return to past stand densities may have some deleterious effects, but I have some concern for that level of retention, in particular regarding the culture of a new Oregon white oak component for these stands. The 15 large trees per acre that occupied this savanna some 100 years ago included about 2.5 large, open-grown oaks. Since most of these oaks are now dead, we will be leaving conifer trees to replace their portion of the stand density, and I am concerned that there may not be adequate growing space to produce vigorous, open-grown oaks with a conifer retention as high as 20 trees per acre. Since the mortality these retained mature trees will experience over the next 20 years will probably not reduce the stand density to levels adequate for the long-term growth of open-grown oaks (as discussed above), it is particularly important to implement the snag creation discussed below once the mortality that can be expected in the retained trees manifests itself, if it is less than five trees per acre.

Pine Retention and Removal - Since this stand has lost over half of all the original ponderosa pine, all pines, regardless of size or age, should be retained unless they are directly impinging upon a live oak or other, larger pine trees. Most of the 100 year cohort of ponderosa pine are not very vigorous trees (with exception of those occuring within or on the edge of the meadows); they have not been able to complete very well against the adjacent Douglas-fir, so they typically have rather slender stems and small crowns. Because of this physical condition, some of these trees are likely to experience either windthrow or, more likely, stem breakage due to snow accumulation on the small crowns. Since we cannot absolutely predict which of these smaller pine may be so affected, it is important to retain all the pine to assure that those which will persist are retained. I expect these unstable stem conditions to improve with time if the trees are not damaged, so the risk of loosing these important legacy replacement trees will diminish over time, and the trees' form should be substantially improved within 10 to 15 years.

Pine Thinning – As previously mentioned, the above excess tree removal applies to all harvest units except Unit 4. Unit 4, as delineated on the EA Alternative maps, consists of a large meadow complex that now contains a considerable number of encroached tree clumps. Many of the encroaching trees are ponderosa pine of the 100 year cohort, but there are some more or less pure clumps of Douglas-fir as well. There are a few legacy pine and oaks on these clumps.
In order to return this meadow to its historic conditions, the pine in these clumps should be thinned. The largest of the pine should be retained on about a 50 foot spacing. All 100 year cohort Douglas-fir, regardless of size, should be removed.

Oak Retention - Nearly all the large Oregon white oak originally in these stand are gone, and all live oaks greater than five feet tall should be retained, protected, and released from competing conifers. All Oregon white oaks with stem diameters greater than one inch should be protected from falling, yarding, and fuels reduction impacts, and any 100 year cohort trees within 50 feet of an oak, of that diameter, should be removed.

Green Tree Retention - The Northwest Forest Plan standards and Guidelines (page C-41) mandates that at least 15% of the area associated with each "cutting unit" should be retained, and further that 70 percent of the retained trees should, "as a general rule" be in clumps at least one half acre or larger. Such green tree retention (GTR) can only occur on Matrix lands (e.g., GTR clumps cannot be deemed to be in riparian reserves), and must include (page C-42) the largest, oldest live trees and hard snags. The rationale behind this mandated retention (NWFP page B-3) relates to the typical condition that the natural fire regime leaves scatted live trees, both as individuals and in patches, and that it is important to provide small refugia to provide for eventual recovery of old-growth conditions. As may be surmised from the discussion of past conditions above, such fire behavior/regimes and objectives do not especially apply to this landscape of frequent, low severity fire regime, and given the fact that the desired conditions for this area to have a perpetually open forest, there seems little point in providing for late-successional refugia. However, the NWFP GTR requirements do not provide any circumstances under which green trees need not be retained.

The prescribed 20 tree per acre retention represents only about 12 percent of these stands on average, so is not fully adequate to comply with GTR requirements. Even if the number of retained trees were increased to equal 15 percent of the existing stand (which would be about 24 trees per acre), such retention would still not comply with the above guidelines since it by and large would not be clumped.

The Jim's Creek ID Team has determined that the best way to provide for the required green tree retention without compromising the needed savanna restoration is to provide clumped retention on the north slope between the proposed harvest units and road 2129, as shown on the Alternative maps. This area contains a higher density of older trees than the areas proposed for density reduction, can be easily protected from prescribed fire due to its topographic position, and as a very important side benefit, would provide for a late-successional habitat connection along the Young's Creek/Jim's Creek watershed boundary. This location may not seem to fully comply with the above direction to associate GTR clumps with "cutting units", since this area is not immediately adjacent to all units identified on the alternative maps. These units (with the exception of Unit 4 and the partial exception of Alternative D) all have the same harvest prescription and are differentiated only by yarding system, primarily to facilitate analysis of environmental and economic effects. Alternatives A, C, and E (with the exception of unit 4) essentially contain one treatment unit within which different yarding systems are to be used, so location of a GTR clump in the above location fully complies with GTR clump location direction. Additionally, if GTR clumps were scattered within proposed harvest units, the proposed maintenance underburning would be more difficult (in that they would have to be protected from fire to preserve the snags), and the clumps would not contain the largest and oldest trees on the site.

<u>Timing</u> – At this time it is estimated that tree removal could begin no sooner than the summer of 2007, if the current schedule for public comment, signing of a final decision, and project layout are adhered to. Completion of the excess tree removal would probably take two operating seasons.

<u>Road Construction</u> - Road 2129.371 is the main access road within the planning area. It was constructed about 20 years ago to facilitate the harvest of the Colt timber sale, which created the four plantations. This road is not adequate to access all of the planning area in terms of road-based harvest systems. Given the presence of listed fish in the main stem of the Middle Fork of the Willamette River immediately below the south slopes of the planning area, and the overall high road density of the Middle Fork watershed, additional road building in this area is essentially out of the question. Fortunately, the trees that need to removed are of a quality and quantity that make their removal by aerial means (such as helicopters) economically feasible, and road 371 provides several logistically and economically viable helicopter landing locations. Therefore, no roads are to be built to accomplish this restoration other than one short temporary spur to access a helicopter landing.

<u>Yarding Requirements</u> - At least one end log suspension should be accomplished, using helicopter or skyline methods. Skyline logging should be limited only to those areas where skyline corridors can be established without the need to remove a legacy tree. Skyline equipment could be used to access much more of the project area than shown on the Alternative maps, but use of this method has been limited by the desire to protect all legacy trees. Skyline yarding requires the creation of a straight corridor by cutting all trees that would be in the way of moving logs. Such corridors, if they extend any distance at all, would very likely entail the

cutting of a legacy trees, therefore, use of skyline yarding has been limited to short distances that will not require the cutting of a legacy tree to create the yarding corridors.

No off road machine use is to occur, neither for yarding trees to be removed, nor to facilitate fuels reduction, in order to avoid soil compaction and disturbance, and harm to residual bunchgrass. The soils in this area are especially fine-textured and relatively shallow, and are very subject to compaction and surface soil erosion.

1. Staged removal, or speed of restoration efforts:

The prescribed excess tree removal will generate a residual tree density very similar to that of a conventional shelterwood harvest (Williamson, 1973), a silvicultural technique that has been used extensively on the Middle Fork District over the last 5 decades, and in large part successfully so. Williamson (1973) was one of the first studies of shelterwood efficacy and he noted that “overstory survival has been excellent with mortality over all units averaging only 2 percent by number of trees”. More relevant to this project is the fact that the planning area contains two 20 year old shelterwood harvest units with an average of about 22 retained trees per acre which have experienced less than an eight percentage mortality in shelter trees over a 20 year period. The retention prescription of 20 trees per acre provides for up to a 30 percent mortality of retained trees before the desired future condition, in terms of residual tree density, would be compromised.

In the final analysis, the excess tree removal prescription above does provide for a conservative amount of tree retention; we would be leaving 30 percent more large trees than were on the site 100 years ago (the Desired Future Condition), specifically to account for anticipated and unanticipated levels of mortality, particularly wind throw or stem breakage below the live crown. While most of these trees are admittedly not as old and as large as the savanna trees which existed on the site 100 years ago, they are none-the-less, large and vigorous trees, indeed the largest available except for the smaller pine that are to be retained for species diversity. Judging from the performance of the trees retained in the 20 year old shelterwoods, I am certain that most of these 100 year old trees greater than 24 inches in diameter will survive and live for several hundred more years, as long as the various requirements of this prescription are followed. These trees, after all, are our best and only option for quickly replacing the legacy trees which have died in the past 80 years.

There are several reasons not to do a phased removal of excess trees, as mentioned in the following Alternatives Efficacy discussion

2. Prescription variation across the landscape

Let’s assume that we are here contemplating restoration 70 years ago, when the encroaching Douglas-fir were just beginning to close their canopy and most if not all the legacy trees (in particular Oregon white oak) were still alive. At that point, the most straightforward approach to restoration would be to eliminate the encroaching younger trees and begin an underburning regime. At that time it would make no sense to say we should reduce the density of those young saplings by X percent here, X percent there, and leave them alone somewhere else. The most sensible approach would be to use fire for their removal, the natural and historic means that this forest was maintained in its open conditions, knowing that fire would result in a dramatic reduction of young conifers but still provide for a variable amount of retention across the landscape. In this case, the restoration would consist of retaining the largest (fire-resistant) trees, where ever they may occur. The above prescription to remove most trees less than 24 inches in diameter should result in a distribution of retained trees in a similarly random fashion to the occurrence of the original savanna trees. This random distribution should result in the creation of occasional openings up to ½ to one acre in size and other areas that could have as many as 25 trees per acre.

D. Snag Retention/Creation

The forest in the planning area contains an average of about 14 snags per acre, ranging in size from 8 to 60 inches in diameter. About 13 of the snags per acre are less than 18 inches in diameter and about one per acre is greater than 20 inches. The larger snags tend to be the oldest ponderosa pine and the smaller tend to be Douglas-fir that have been suppressed out of the 100 year cohort. These standing dead trees play an important habitat and site productivity role in forested habitats, but the original savanna likely had few snags and the ones that did periodically develop were not likely to persist on the site very long due to the frequency of underburning. Snags present a considerable safety concern when excess trees are being removed or when burning is occurring, as they can fall unpredictably and inflict serious injury or death to forest workers.

Nearly all the snags (other than those most recently dead which are sound and unlikely to fall if influenced by machinery) will need to be removed from within harvest units under all action alternatives. Helicopter use is of special concern, since even the rotor down wash, in addition to swinging logs, can cause a deteriorated snag to fall unpredictably. There has been some biological concern expressed regarding the need to fall most or all the snags within treatment units, given the habitat values snags typically provide. One of the reasons for proposing the retention of 30 percent more leave trees than described in the Desired Future Condition is to provide the opportunity to create new snags after tree removal activities are completed, should a sufficient number of snags not be created naturally through leave tree mortality as contemplated above. It will also be important to create some snags within the existing shelterwood plantations.

Concerns relating to the short-term loss of this important structural habitat should be minimized with the understanding that such habitat will occur in the large and wide riparian reserve that will be maintained along Deadhorse Creek and along the Middle Fork of the Willamette River, and in other untreated areas to the north and west of the treatment areas, and the fact that there are abundant standing dead trees in the 1996 fire complex that affected over 500 acres in the upper reaches of the Deadhorse and Simpson Creeks about one mile northeast of the planning area.

Timing: Before snags need to be created as discussed above, at least five years should elapse to make sure any potential mortality will manifest itself before additional trees are killed. At that time, if there is more than an average of 15 trees per acre, snags should be created across the treatment areas to bring the stand density close to the desired future condition. Trees selected for snag creation should not be legacy trees nor the larger of the 100 year cohort in the interest of replacing large savanna trees as quickly as possible. Douglas-fir should be preferentially selected for snag creation since they will persist far longer than pines. This would result in creation of more snags than required by Northwest Forest Plan direction (USDA/USDI 1994, page C-42). These snags should be created by topping since there are indications that snags created by girdling do not stand as long.

E. Large Wood Debris Retention

Both the Willamette National Forest Plan (FW-212) and the Northwest Forest Plan (page C-40) require retention of down logs after timber harvest to provide a renewable supply of large logs well distributed across the landscape in a manner that meets the needs of species and provides for ecological functions. The Northwest Forest Plan direction in most situations supercedes that of the Willamette Forest Plan and specifies that least 240 lineal feet of logs greater then 20 inches in diameter and 20 feet long be retained in regeneration harvest areas, and further specifies that in areas of partial harvest (such as what is being proposed in the Jim's Creek Project) the same basic guidelines should be applied but they should be modified to reflect the timing of stand development cycles where partial harvesting is practiced. The Northwest Forest Plan also directs that models for groups of plant associations and stand types be developed, and further directs that woody debris already on the ground should be retained and protected to the greatest extent possible. The NWFP says that these guidelines are meant to provide for initial guidance but further refinement will be required for specific geographic areas through planning based upon watershed analysis and the adaptive management process.

It is somewhat uncertain to this prescription writer how to comply with the above guidance and still provide for restoration of the Jim's Creek savanna. There appears to be little recognition in either of these documents of the fact that there may be some instances in which retention of this much down woody debris would be difficult at best or even counter to biodiversity maintenance goals. While the initial proposal to remove excess 100 year cohort trees does not include removal of the existing down wood, this material will almost certainly be consumed by the prescribed fuels reduction and/or subsequent maintenance burning. The fact that this savanna vegetation type did not originally contain much down woody material due to the frequent nature of fire (see also the discussion of down woody material levels in the Wildlife Report, the historic conditions narrative in the Ecology Report, and the Fire Regime Condition Class discussion in the Fuels Report contained in the project's Analysis File) would indicate there is no need to retain such structures for this project. The Hill's Creek Reservoir Watershed Analysis also recognizes this reality (see pages 3-17 and 4-25).

While this prescription provides for creation of adequate amounts of large woody material through the natural mortality or felling of the five trees per acre that are to be retained in excess of the Desired Future Condition (to provide for a hedge against unanticipated mortality), it should be clearly recognized that these fallen trees will relatively quickly (in term of the stand's development) also be, for the most part, consumed by the prescribed underburning. I believe that the analysis done for this project, in conjunction with the Watershed Analysis's finding that areas with a frequent fire return interval had low amounts of large woody debris historically, constitute the specific geographic areas planning based upon watershed analysis mentioned in the NWFP, and this analysis indicates there is no need to retain, over time, the levels of large woody debris prescribed in the Willamette National Forest Plan and the Northwest Forest Plan.

F. Fuels Reduction/Site Preparation

The proposed harvest will generate a fuel loading in excess of the limits set by the Willamette National Forest Land and resource Management Plans standards and guideline FW-252. Slash disposal will need to occur in all harvest units to reduce the risk and intensity of future wildfire, as well as to create a bare soil surface suitable for seeding of California fescue, but all the slash does not need to be entirely disposed of.

Slash generated by the excess tree removal should be burned in the fall after enough rain has fallen to moderate fire behavior such that fuel loading can be reduced to less than 11 tons per acre (FW-252) without undue impact to the retained trees, as prescribed in the Operations Plan and as further discussed in the Jim's Creek Savanna Restoration Project Fuels Prescription. There is a need to reduce fuels to provide for suitable seed beds for the oak and grass seed that are to be planted, the greatest amount of growing space for to provide for future, low hazard prescribed burning, as well as to lower the risk of catastrophic future wildfire. It is imperative that burning not occurring during the growing season, which in this area begins in early March (for root growth) and ends in late August.

How these fuels are reduced is, in my mind, one of the toughest questions to answer regarding the overall restoration success. Slash burning can potentially have several effects that would be detrimental to successful restoration of various savanna components. Of most concern is damage to the legacy ponderosa pine. Though these trees have experienced low ground fires many times, they have not for over 100 years, and a substantial amount of duff and litter have accumulated around the base of most ponderosas. Broadcast burning could severely injure these trees, and likely kill them if fire is allowed to burn in these duff collars without prior treatment. Burning anywhere near ponderosa pine during the growing season (approximately March through July) has been shown to increase the chance of tree mortality, either through radiant heating of the crown or damage to fine surface roots in areas where fires has not burned for decades, allowing an accumulation of duff. Slash piling using machinery would also likely cause extensive disturbance to remnant bunchgrass plants.

Slash created by the excess tree removal should be reduced either by hand piling and burning, or by broadcast burning as long as the following criteria can be met: Duff moistures should be in excess of 30 percent to avoid full duff consumption. Slash concentrations should be pulled away within 10 feet of all legacy pine and Douglas-fir, and the duff accumulations within 3 feet should be pulled away from all legacy pine bases. Slash accumulations within 20 feet of all live oaks greater than four inches in diameter should be removed. No burning should occur between March 1 and July 31 (the active growing season).

There is a similar concern for the persistence of native bunchgrass in terms of how slash burning might affect it's vigor. Sparse clumps of California fescue still occur scattered throughout the Jim's Creek forest. I have noticed that the 60 or so acres underburned during the 1996 wildfire (in the northeast corner of the planning area) contain many less of the residual bunchgrass plants than unburnt forests do. My assumption is that this fire impinged upon those remnant plants, which received no benefit from the fire in terms of increased light levels since few overstory trees were killed. This is not to say that any fire effects would necessarily be detrimental to residual bunchgrass, because I have observed good bunchgrass recovery in harvest units that were burned, but it does point out that these remnant plants of low vigor are vulnerable to disturbance. Though this prescription recommends that supplemental bunchgrass seeding be done even though we have seen good bunchgrass recovery without seeding, it seems prudent to protect these remnant plants as much as possible given the disturbance that will occur during tree removal.

Timing: Harvest generated fuels should be reduced as specified above and within the Fuels Prescription contained the project's Analysis File, as soon as practicable after excess tree removal is completed. Bunchgrass and oak planting cannot occur until fuels have been treated, and it is imperative to accomplish that planting as soon as possible to reduce the likelihood of non-native species invading the area, or of expansion of the existing brush layer to the point that it could compete with newly established plants.

G. Planting/Reforestation

Oregon white oak: Though natural oak regeneration can be expected after excess tree removal provides a good seedbed and adequate light for seedling survival, as evidenced by the more than 2 oak clumps per acre that have become naturally established in most of the 20 year old plantations, oaks should be planted to make sure there are enough oak to provide for adequate savanna restoration even with some mortality from the prescribed out-year underburning mentioned below. There are three basic ways to accomplish oak reestablishment; planting acorns directly, planting of bare-root nursery stock, and planting containerized seedlings. Some investigators (Niemic, et. al., 1995) have noted that cultivated oak seedlings grow rapidly and do not display the prolonged shrub stage observed for many wild seedlings, so we may want to spend more effort on seedling culture and planting than on direct seeding, since one important objective is to get the oak saplings to a size suitable for survival of prescribed fire as soon as possible. On the other hand, direct seeding would be considerably cheaper and may offer more flexibility to get seedlings established quickly given the episodic nature of acorn production and the length of time it will take to grow an adequately sized seedling. It may be desirable to try some limited planting of bare root seedlings but given that oak quickly develop a deep taproot (USDA, 1990b), I question how effective this method may be, I recommend that direct seeding and planting of containerized seedlings primarily be used for oak reforestation efforts since bare root oak seedlings may not survive well. Locally collected seed should be used for all three methods. Acorns can be collected from any vicinity within 20 miles of the Jim's Creek site, including the planning area itself, the oak groves at Packard Creek Campground, or from the many oaks in and around the Oakridge community.

It should be noted that Oregon white oak acorns do not develop dormancy (USDA, 1974; USDA, 1990b). Acorns ripen from September to November (USDA, 1990b, and personal observation). They remain in an active state and require moisture or they will dry out and die and must be kept moist to germinate (USDA, 1974; USDA, 1990b) . They can be held for no more than a few months after being collected and are known to begin germination in cold storage (USDA, 1990b; USDA, 1994, personal experience). Freezing will kill an acorn. Successful oak regeneration will be contingent upon anticipation of when the site will be ready for planting, collection of an adequate number of seed early enough to facilitate out-planting and seedling culture, and development of an appropriately sized seedling.

Seed production is irregular (USDA, 1990b; Harrington and Kallas, 2002). Only two good acorn crops have been noticed in the Jim's Creek area since 2001. Personal communication with Forest Service Regional Ecologist Louisa Evers indicates the oaks in this vicinity are likely uniform enough to be inter-planted across a fairly large area. The USDA Handbook Silvics of North America (USDA 1990b) also indicates that the genetic variation between Oregon white oak populations is very minor, even across its entire range. Additionally, the seed zone that includes the Jim's Creek area (Randall, 1996) includes the Oakridge area, and the entire Middle Fork Ranger District.

Location of oak reforestation Oregon white oak grow in diverse climates and has the greatest north-south range extent of any western oak. It can grow on a variety of sites, but on good sites it is often crowed out by faster growing tree species. It can grow to large sizes but is also found extensively as scrub forest (USDA, 1990b). The presence of Oregon white oak is determined by one of two things; either the site experiences periods of drought (either physical or physiological) to which oaks have a physiological advantage over other tree species, or the site is subjected to a disturbance regime (such as fire) to which other potentially competing tree species are not as well adapted. During the development of this project some have expressed the opinion that the oaks must be growing where they are for a reason, and that we would only want to/need to plant oak seedlings where they used to or still do occur. Of course, if oaks still occur in an area, there is little need to plant additional trees.

Given the literature citations regarding the apparent wide ecological amplitude of Oregon white oak, the fact that oaks can be found in some amount on just about every slope in the planning area, and the relative consistency of the soils occurring in the planning area, I am not at all convinced that oak site requirements are all that specific such that we should restrict oak reforestation efforts to only certain spots that happened to have oak growing in them 100 years ago. And of course we can only tell where oak did grow 100 years ago from the presence of relatively large trees; there could have been many more stems per acre 100 years ago of smaller diameter or shrubby oak whose stems were too small to leave any evidence 80 years after their death. Indeed, there could have been numerous small oak shrubs to occasionally provide for one tree which was able to get large enough between fires to be resistant to future fire effects.

Given the above rationale, I recommend that oak be planted throughout the treatment area, aside from the interior of meadows and one plantation (stand #2772) where there are already more than 2 oak clumps per acre. These oaks should be planted preferentially in canopy gaps and small openings, and should not be planted within 100 feet of a live oak of any size. About half the trees planted should be two year old, containerized seedlings with a basal stem caliper equal or greater than 6 millimeters (as per Devine and Harrington, 2004). These seedlings should be protected from browse damage by solid tree shelters for the first two years. The other half should be planted by direct seeding. There should be no immediate need to provide for competing vegetation control if the seedlings are planted when recommended below, but the development of such competition should be monitored.

Seedling planting should be done in the early spring at about ten trees per acre on the average. An additional 50 acorns per acre should be planted (to account for an expected high predation rate by stellar jays), again in appropriate sites as described above, in addition to selecting sites with a good duff layer for seed protection, across the same areas planted to seedlings. Acorns should be collected from the local area (they are usually ripe in mid to late September), tested for viability by visual inspection and float testing, and planted immediately. Care should be taken to plant acorns so that their axis is horizontal and at least two inches under the litter or soil surface. Personal experience has shown that the aerial shoot of an oak tree exits the acorn from the pointed end; planting the acorn point down may seem intuitive, but that results in the aerial shoot having to make a 180 degree turn, which can result in delayed emergence at best or seedling death.

Certainly not all these young oaks will survive the initial planting, and many are likely to be repeatedly killed back by the maintenance underburning. Since our understanding of what it takes to get an oak established and grown to maturity, I do not think it prudent to limit the areas we plant at this time.

<u>Pine:</u> The environment created by the proposed understory tree removal, subsequent fuel reduction, and prescribed maintenance burning should be ideal for the natural germination and growth of ponderosa pine seeds. In fact regular prescribed burning is very important to continually reduce the amount of conifer seedlings that would relatively quickly occupy the site again as they did 120 years ago. Therefore, I see no reason to plant ponderosa pine now or in the future, unless some extraordinarily hot fire burns the entire site and kills all the young pine. The desired variable extent and severity of the out-year prescribed burning will provide for occasional survival of pine seedlings to a size that will be resistant to subsequent prescribed fire, thereby providing for eventual replacement of large trees as they die.

Sugar Pine, on the other hand, will need to be artificially planted in order to restore this minor component of the historic savanna. The few sugar pine that were part or the 100 year cohort forest have for the most part succumbed to blister rust mortality. About six rust resistant, 2/0, bare root sugar pine seedlings should be planted in areas where excess trees are removed, concentrated on the lower slopes.

<u>Grass reestablishment</u>

While California fescue bunchgrass (*Festuca californica*) is likely to reestablish with little help from us, as evidenced by its performance on the four plantations which were created in this planning area some 20 years ago, (likely from the presence of residual plants) it would be wise to do supplemental seeding of this species. To that end, grass seed should be collected and quantities increased by nursery grow-out, as detailed in the Botanical Report (see the project Analysis File) before understory density reduction and subsequent fuels reduction activities are completed. Once fuels reduction is completed, grass seed should be sown immediately to take advantage of the newly exposed planting sites. How much grass seed to sow is a difficult question to answer. More is always better (Macdougall and Tukingtom, 2004), but we will likely not be able to generate enough seed to plant every acre with the desired amount of seed. If Alternative E is selected (444 acres of planting needed), some 20,000 pounds of grass seed would be needed to plant the entire area with a fairly conservative 50 pounds per acre. The collection and grow-out of that much seed is not realistic. It is recommended by the ID Team botanist to sow 10 lbs./ac. as a hedge against poor response from the residual grasses, or to supplement in areas with little residual bunchgrass.

On the other hand, we do not want to establish only California fescue in the areas of restoration. Many other plant species inhabited the ground vegetation layer, and we will want to do some supplemental planting of those species, such as camas and yampa (*Perideridia gairdneri*) as well. The more grass seed that is planted, the more competition would be generated for other species we would like to see established.

Timing: All planting should be done as soon as seasonally possible (either in late fall or early spring) once fuels reduction activities are completed and soil moisture levels are high. Ideally, acorns should be planted in the fall just before the first expected snow fall, not to exceed two months from initial collection of the acorns. It is very important to get these various plants established as quickly as possible to avoid undue competition from shrubby species and potential invasion of non-native, noxious plants. It is also very important to plant oak before or concurrently with grass seeding, as the native bunchgrass can be very competitive with oak seedlings (Campbell, XXXX; Niemic, et. al., 1995) once it is well established.

H. Thinning of plantations

The 67 acres within the four harvested stands in the planning area are to be folded into the restoration of this savanna. The shelterwood overstories which cover about 36 acres of these plantations are approximately at the density prescribed for the surrounding or adjacent natural stands, and these overstories should be left as they are. The density of the 18 to 20 year old trees that have become established in these areas after the past harvest should be further reduced to provide for continued vigor and recovery of the bunchgrass and oaks that have also developed within these younger stands.

All four of these plantations were precommercially thinned in 2002 to approximately a 12 foot spacing between younger trees, leaving somewhat less than about 300 trees per acre. When these stands were thinned the existing oaks were favored, but young stands at this density will quickly close their canopy, and the future vigorous growth of those oaks, considering the height growth advantage that conifers have over oak, is dependant upon further stand density reduction. These stands are also to be underburned as described below. If prescribed fire does not materially reduce the stand densities in these plantations, they should be further thinned to less than 100 trees per acre with a variable spacing between retained trees, which should be the largest ponderosa pine and other conifers on the sites. All Pacific madrone should also be releaseed, as well as the oaks.

I. Underburning in plantations

All the plantations mentioned above have developed a more or less continuous cover of the native California fescue bunchgrass, though the grass cover is less dense in the shelterwood stands since there is less sun getting to the ground. The shelterwoods also contain considerably more hardwood species than do the two even-aged plantations, and this shrub and hardwood understory is also competing with the bunchgrass and young Oregon white oaks. These plantations should be underburned soon, and incorporated into the maintenance underburning described in the next item below. The bunchgrass in the two even-aged plantations is much denser and well established than in the shelterwoods, but it beginning to loose some vigor due to the accumulation of a grass thatch. This bunchgrass is fire dependant, as evidenced by its response to recent test burning (Bailey, 2005) and needs to have accumulated biomass removed periodically through fire to be at its most productive. Such underburning may also help in reducing stand density as mentioned above, and would reduce the fuels created by the previous pre-commercial thinning and make these stands less prone to damage from extreme wildfire.

Timing: The first iteration of this burning was implemented in the spring of 2005 within the larger of the even-aged pine plantations(see Bailey, 2005). The results of that first test were very satisfactory, and the other three plantations should be burned the following spring. Subsequently, plantation burning should be accomplished along with the maintenance burning described below.

J. Underburning to maintain savanna conditions

A periodic underburning regime is probably the one activity as important as excess tree removal to the ultimate success of savanna restoration. This prescribed fire will be extremely important in maintaining a low stand density by eliminating the many conifer seedlings, shrub species, and even noxious weeds that are expected to constantly invade the new savanna. Prescribed fire would also have the general benefits of maintaining the vigor and dominance of the native ground vegetation.

Mowing as an option to maintenance burning has been proposed due to concerns for fire escape risk and smoke production. I do not recommend such a practice. Mowing would be more expensive than burning, given that the area to be restored is strategically located such that good burning boundaries are located and a certain amount of fire escape risk is acceptable (e.g., if no risk of escape is acceptable, burning would be very expensive in terms of the need to build fire lines, run fire hose, and man the fire perimeter), and more importantly, mowing requires equipment travel across the slope, periodically, on every acre. Such use of tractors would, over time, compact the soil, potentially damage standing trees, seedling and saplings, would likely not be able to treat the steeper slopes safely, and would provide a periodic opportunity for noxious weed entry. Additionally, mowing would not reduce the amount of biomass on the ground immediately, would not result in the same nutrient flush that fire would generate, and in an overall sense, would not at all provide for the type of disturbance regime to which California fescue and a number of other native grassland plants have evolved to thrive under.

There is a disconnect between society’s new-found realization that fire is an important ecological process and the lack of acceptance for visibility reductions of any kind from prescribed fire generated smoke. Smoke from prescribed fire application designed to mimic natural and historic processes are looked at, from a regulatory perspective, in the same light as industrial sources. If we as a society cannot come to realize that fire, and all its effects and opportunities, is a natural part of our world, then it would seem that maintenance of naturally functional ecosystems such as prairies and savannas is not that important after all. In that case, this restoration effort should be abandoned and the area allowed to develop a closed canopy forest once again, and we can wait for the next uncontrollable wildfire to come through, since wildfire smoke is not regulated by the Clean Air Act.

Meadows and Plantations: These areas, once initially treated, should be treated periodically along with the remainder of the restored savanna, to assure maintenance of open conditions and to make future prescribed burning most efficient. It is the intent of this prescription that both the clearcut and shelterwood plantations be folded into the overall restoration effort. The prescribed pre-commerical thinning, snag creation, and underburning should serve to blend these areas into the larger landscape such that at some future time it would not be readily apparent that these areas were once treated differently.

Timing: Though there are few accounts of native American burning, and none for this specific area, it is very likely that the Native American burning that maintained the original savanna vegetation was done in the late summer or early fall, and that it occurred very frequently, perhaps every year during some periods (Towle, 1982). Ideally, this is the time periodic underburning should occur, as it is this period of the year when plants of all kinds are best physiologically suited to withstand the effects of fire. Tree root growth is more or less dormant and grasses have stored enough food through the growing season to facilitate vigorous growth once the winter rains come. Unfortunately, burning during this traditional period presents some problems in today's society that essentially make at least the first iteration of burning nearly impossible to do in the late summer or fall. The risks of burning in the middle to end of this typically dry season, added to the fact that there is private forest land only about one mile to the east of the project area, means that traditional late-season burning is so risky as to be out of the question, or would be extremely expensive if all risk reducing mitigations were employed. A test application of prescribed fire timing has been instituted in a previous decision relating to this restoration, the Mutton Meadow test burn (USDA, 2004). Results of this testing should give us a better idea of the conditions we can burn under and still retain other resource objectives.

Therefore, I recommend that the periodic underburning be at least initially conducted earlier in the year, prior to the advent of root growth in the retained conifer trees, and before the bunchgrass starts its new growth. This would generally be in the months of January or February. Fortunately, this portion of the District often experiences a period of one to several weeks in those months with sunny skies and no precipitation that can dry out fine fuels to the point they will burn well without the risk of consuming larger fuels and generating aggressive fire behavior. Pine root growth is known to begin as early as late March. Slash burning in late May to early June in group selection harvest units (where all pine were retained) in an area just north of the Jim's Creek planning area resulted in morality of about half the pine. Some trees succumbed to bark beetle attacks, even those which had no fires scorch on their stems. Upon investigation (Agar, personal communication, 2000) it was determined that the pines' fine feeder roots were in the duff or on the duff/soil interface and were activly growing at the time of prescribed burning. Since these trees had not experienced fire in about 100 years, possibly more roots than normal under a natural fire regime were in the organic portions of the soil profile. It was surmised that the trees were stressed by the fire's impact to the fine roots, and that stress resulted in successful bark beetle attacks.

Though the periodicity of these prescribed burns may be outside the scope of this particular prescription, and monitoring of the effects of the first would be instrumental in determining the frequency of prescribed fire, I do expect that this burning should be relatively frequent in order to mimic the way fire molded these stands in the past. Since the fire scar record shows fire return intervals which averaged six years and were as frequent as every several, I recommend that we think about applying prescribed fire at least once each five years, though conifer seedling density could also be used to monitor the need for fire.

Additionally, as mentioned above under the fuel reduction section, before broadcast burning is implemented, the accumulation of duff and litter ("duff collar") should be physically removed from around the base of all legacy pines trees to assure these trees are not affected by long-term smoldering fire right at the base of the trees. In many case, these trees have in excess of one foot of duff accumulation at their base, which has accumulated over the 100 years of fire suppression.

K. Riparian Reserve Management

The Northwest Forest Plan ROD requires that riparian reserves for all stream classes be deferred from programmed harvest (page C-30 and 31). Riparian reserves for non-fish bearing streams (class III and IV) are defined by the slope distance from the channel edge of one site potential tree height, the height a tree can attain on a given site in 200 or more years. Riparian reserves for fish bearing streams (classes I and II) are to be two site potential tree heights from the channel edge. Site potential tree heights for stands in the Jim's Creek area range from 150 to 175 feet.

While it may not seem intuitive that large-scale tree removal within riparian reserves needs to occur to restore the diversity of species, the analysis contained in the Jim's Creek Savanna Restoration project EA has determined this does need to occur to restore the riparian ecosystem in the Jim's Creek area to what it used to be like (see the Desired Future Condition narrative above). There are about eight class IV streams, in addition to Jim's Creek itself, in the project area. All are short and were at one time part of the savanna vegetation. The Northwest Forest Plan (USDA/USDI, 1994) contains the Aquatic Conservation Strategy objectives which mandate riparian area restoration. Specifically, objective #1, "maintain and restore the distribution, diversity, and complexity of watershed and landscape features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted", objective # 5, "maintain and restore the sediment regime under which aquatic systems evolved", objective #6 " maintain and restore in-stream flows to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment nutrient and wood routing; the timing, magnitude, duration and spatial distribution of peak, high, and low flows must be protected", objective #8 "maintain and restore the species composition and structural diversity of plant communities in riparian areas..", and objective #9, "maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian dependant species" all support the need to restore the class IV riparian reserves in the Jim's Creek area to their once more open condition.

Class IV riparian areas within savanna restoration areas should be treated in a similar fashion to upland areas that are to be restored, other than no trees within 50 feet of the channel's edge should be cut to provide for bank stability. This riparian reserve was originally part of the savanna vegetation complex and needs to be included in the restoration efforts to comply with Aquatic Conservation Strategy objectives, as discussed above. Jim's Creek, and the other unnamed streams are class IV streams, meaning they do not flow year around. Since an increase in stream temperature is of most concern for the Middle Fork of the Willamette River (USDA, 1995, pages 4-15 to17) and such an increase is a summer phenomenon, occurring when the streams in the planning area have no flow, there is no need to maintain all shading vegetation along the these ephemeral channels. Therefore, this prescription is in compliance with the Forest Service's Northwest Forest Plan TMDL implementation strategy (USDA/USDI, 2005). It should also be noted that the Watershed Analysis covering this area (USDA, 1995, page 6-8) specifically recommends that low intensity underburns be tested in some riparian reserves to better reflect historical levels of fuels, and to help meet the Aquatic Conservation Strategy objectives of restoring species composition and structural diversity of plant communities.

The Jim's Creek riparian reserve was originally typed as a Class IV stream. Reconnaissance over the last several years have revealed conditions that make classification of this stream (and hence determination of how its riparian area should be managed) somewhat difficult. Class IV streams are defined as those which are ephemeral or intermittent. Ephemeral is defined (FEMAT, 1993) as streams that contain running water only sporadically, such as during and following storm events, and intermittent is defined as any non-permanently flowing drainage features having a definable channel and evidence of scour and deposition, including what are some times referred to as ephemeral streams, if they meet those two criteria. Observations of Jim's Creek over the past four summers show that this stream does not have continuous flow entering the Middle Fork River during the latter part of the summer (after mid-August). Its does, however, contain scattered small pools (few larger than three feet by 2 feet by six inches deep) that generally do not (but occasionally do) have overland flow connecting them. As such, this stream is somewhat in-between an intermittent stream and a permanent stream, so the 50 foot buffer discussed above for Class IV streams will not be used. Yet there is not a pressing need to provide a full riparian buffer (which would limit the achievement of the restoration goals and desired future condition for this project) in terms of maintaining stream temperatures, since this stream does not flow into the Middle Fork River during the portion of the year when the river temperature is elevated. To protect the important microhabitat represented by the small pools that remain in the Jim's Creek channel into late summer, the protective riparian buffer should be located on the topography break that defines what is called the "inner gorge" (see the Fisheries and Watershed Report in the Analysis File), to protect all areas associated with the channel and the steeper slopes adjacent to the channel. This boundary should also include any special features or habitats such as small wetlands and in particular should include the small recent debris torrent scar and deposition adjacent to Jim's Creek several hundred feet below the 371 road. This riparian buffer would likely average around 50 feet either side of the channel edge, but would vary from 15 or 20 feet to over 100 feet either side of the channel in places.

As mentioned in the Fisheries and Watershed Report (contained in the project's Analysis File), implementation of the proposed excess tree removal may slightly change the timing, magnitude, and duration of peak stream flows due to a reduction in the conifer canopy cover. The conifer density reduction would also increase soil moisture and below ground water routing since it would significantly reduce the amount of transpiring vegetation, so it very well could also result in increased stream flows, to the extent that the class IV streams could become class III streams, or at least would flow longer into the summer than do these streams now. In that sense the proposed actions would be imperative to achieve Aquatic Conservation Strategy objectives #6, as quoted above. It should also be noted that if we follow the literal focus of the riparian reserve guidelines and retained a full width no-treatment area along all nine class IV streams, less than half of the needed restoration would occur, and prescribed burning would be extremely difficult due to the need to keep fire outside of riparian areas.

While the Watershed Analysis (USDA, 1995 pages 4-7 to 9) does mention that debris torrents have increased as a result of forest management (primarily due to roads) and that harvest activities have resulted in the loss of root strength that held banks together (USDA, 1995, page 4-

13) making them vulnerable to erosion processes associated with storm event, it does not mention any sedimentation or turbidity related water quality concerns or effects.

The Deadhorse Creek riparian reserve would be protected from any water quality changes with a two site potential trees height buffer (in this area, about 340 feet slope distance). Deadhorse Creek is a class II, fish-bearing stream and as such, temperature increases are of paramount concern. Additionally, judging from the structure of the vegetation in the vicinity of Deadhorse Creek, this area was not part of the more open savanna complex. Though the forests along Deadhorse Creek were more open than they are now, judging from the number of older trees in this general vicinity and the plant associations occurring in this area, the canopy closure in the Deadhorse Creek riparian reserve was probably in the vicinity of 40 to 50 percent 100 years ago.

There are no wetlands separate from the riparian reserve system in areas proposed for treatment. Wetlands should be treated in a similar manner; retain a 50 foot wide unthinned area along their length. Small seeps need to be protected from physical disturbance, but they do not need a full buffer unless the are connected to the stream network

L. <u>Maintenance of Long-Term Site Productivity</u>

Long-term site productivity can be degraded by soil erosion or loss; soil compaction; extreme heating of upper soil horizons; retention of low amounts of litter, duff, and large woody debris; loss of mycorrhizal communities; or loss or suppression of early and late-successional nitrogen fixing flora.

There is a commonly held perception that harvest of trees removes great quantities of nutrients and disrupts nutrient cycling and replenishment. While this may be the case in situations where harvesting is not properly planned and implemented, it should be noted that in the natural functioning of this ecosystem, wildfire often can have the same or even more severe effects as does harvesting (Kraemer and Hermann 1970), especially in the instance of reburning. The Middle Fork Willamette River Downstream Tributaries Watershed Analysis (USDA 1995, Characterization, page I-4), has determined that wildfire has been a common occurrence in this area, as is also evident in the age class distribution and structure of the stands this planning area contains.

In general, long-term site productivity depends upon maintaining the nutrient capital and beneficial soil conditions of a given site. In most cases nitrogen is the nutrient of interest as it is generally nitrogen that limits plant growth in the Douglas-fir ecosystem. Nitrogen compounds are fairly soluble in water and can be lost to leaching given the amount of rain that falls in this ecosystem (Harvey et al. 1979; Sollins et al. 1980). More importantly, nitrogen compounds are typically and to a large extent volatilized by fire, and hence lost (for a given site at least) to the atmosphere (Kraemer and Hermann 1979, Boerner 1982, McNabb and Kromack 1990), a particularly common cause of nitrogen loss given the frequency of fire in this ecosystem.

This ecosystem has developed strategies to cope with these periodic nutrient losses; first is the conservation of nitrogen by the plants and soil biota (Sollins et al., 1980; Boerner, 1982). Once it is absorbed, these organisms retain and recycle their nitrogen very efficiently. Secondly, the ecosystem contains a number of species that have developed the ability to create their own nitrogen compounds from atmospheric nitrogen, notably (in descending order of amounts produced) early successional herbaceous and woody plants, mid- and late-successional arboreal lichens, and bacteria that live in very old, decaying logs (Kraemer and Herman, 1979; Boerner, 1982; Klock and Grier, 1979; Waring and Franklin, 1979; Zavitkovski and Newton, 1968, Sollins et al., 1980; DeYoe and Kromack, 1983). As long as these nitrogen creating processes continue, nutrient losses from wildfire, managed fire, or harvest will not, over time, materially affect the long-term productivity of these sites, as long as such disturbances are not too frequent (Kraemer and Hermann, 1979; Harvey et al, 1979).

The proposed tree removal will have the following effects on the previously mentioned components of long-term site productivity:

<u>soil erosion</u>:

The most common form of soil erosion that occurs in this ecosystem is the occurrence of debris torrents. (USDA, 1995, pages 1-3; 3-8,9; 5-13,14) Soils in the western Cascades are typically very permeable; overland flow, resulting in sheet and gully erosion, does not often occur unless water is intercepted and re-routed by road construction, or unless the soil has been compacted (Johnson and Beschta, 1980; Harr, 1977; Rothacher et al, 1967). This higher soil permeability is due in large part to the development of soil aggregates which are created by compounds such as polysaccharides, created by microbial activity, which serve to glue together the small mineral particles of the soil (Lynch and Bragg, 1985; Perry et al., 1989). These processes are driven in large by the presence of organic material on and within the soil upon which the micro-organisms feed. While the Watershed Analysis mentions in passing (USDA, 1995, page 2-2) that the amount of harvested related vegetation disturbance has affected surface erosion and mass movement rates, no specific evidence or data is presented to document how much erosion (as opposed to debris torrents; see below) has occurred, or whether erosion has created sedimentation problems in the riparian reserve system. The Fisheries/Watershed Report done for this analysis models potential soil movement. Most of the potential soil erosion would be generated by the prescribed burning.

Swanson (1981) and McNabb and Swanson (1990) indicate that the frequency and severity of wildfire affects the magnitude of the resultant soil erosion and that the magnitude of fire-accelerated soil loss from forest soils in the Pacific northwest is usually minor because the times and situations when fire severity, inherent soil erodibility, steepness of slope, and the occurrence of intense precipitation before revegetation all coincide are rare.

Debris torrents begin in areas where soil and organic material have collected in bedrock depressions over long periods of time, typically in drainage headwall areas. They typically occur where rooting strength has been reduced by tree mortality, where soils have become saturated with water (usually during infrequent, intense rain storms), or most typically when both these occurrences coincide. Debris torrents are natural events and are difficult to predict. They occur even in undisturbed forests, but they do tend to occur more often in stands recently killed by fire or harvest since it is in these areas where rooting strength is reduced as dead tree roots deteriorate. Debris torrent initiation due to the proposed excess tree removal is not especially likely due to the fact that a live root mat would be retained in that 20 of the largest trees (with the largest root systems) would be retained, and a dense stand of bunchgrass would be established.

Though only about 12 percent of the existing trees would be retained, as much as 50 percent of the existing root mass would persist on the site for some time, given that the largest trees are to be retained and the common occurrence of root grafting.

Road construction may have a greater potential for initiation of debris torrents if water is intercepted and re-routed to areas that otherwise would not tend to experience soil saturation. This project does not propose road construction.

soil compaction:

Soil compaction can reduce long-term site productivity by reducing the rooting zone in the soil profile and thereby reducing the site class (or the height growth of trees) of the compacted area, essentially by reducing the amount of water and nutrients available to plants. Uncontrolled movement of logs with ground-based machinery typically creates a significant amount of compaction (Allen, 1997). Due to the fine-textured soils in this planning area, few acres of the previously harvested stands have been yarded in this manner, so the area contains little soil compaction other than that done in the course of road construction. Portions of the two even-aged plantations (totaling about 28 acres) however, were tractor yarded during the original harvest, and those acres are likely compacted in excess of the Forest Plan standards mentioned below. All proposed harvest areas would be yarded with equipment and/or transportation designs that will result in much less than 20 percent of the area in a compacted condition (FW-081, and see the Watershed/Fisheries Report in the Project's Analysis File). This will be accomplished by requiring cable or helicopter yarding in all areas, with at least one end log suspension. Slash disposal will be accomplished by hand to avoid, among other undesirable effects, the small amount of compaction that would occur if grapple machinery were used to pile slash.

soil heating:

When an area burns very hot, the top inch or so of the soil can be heated to the extent that nutrients are volatilized, soil structure is degraded through volitization of organic compounds, and the soil may become water repellant for a period of time (Boerner, 1982). This extent of soil heating is not widespread after natural wildfire and usually only occurs as the result of managed fire where large amounts of fuels were consumed, as under large piles of slash. Generally speaking, prescribed fires do not result in any long-term impacts to the soil (Kraemer and Hermann, 1979). The proposed slash disposal and subsequent underburning will be done under fuel loading and/or moisture conditions such that very little heat will be transmitted to the soil. See the discussion under duff and litter below as well as the discussion on soil heating contained in the Fuels Report for this project contained in the Analysis File.

duff and litter retention:

These organic components of the soil profile are important to long-term forest site productivity in that they contain a certain percentage of the soil's nutrient capital (Sollins et al., 1980). This nutrient location is especially important in younger, poorly weathered and developed soils, which are rare to non-existent in this area (Boerner, 1982). For most soils in this area, the mineral portion of the soil profile contains a high percentage of soil nutrients. Duff and litter layers are typically consumed during wildfires, so loss of these nutrient stores is not unusual nor especially detrimental as long as such losses do not happen too often (Kraemer and Herman, 1979). The proposed restoration would substitute a grass layer for the existing duff and litter, so there would still be a substantial reservoir of organic material for input into the soil system.

The fuels reduction prescribed will not materially affect the overall soil resource. Fuels would be treated by piling and burning, but the amount of fuels removed would not be especially large; in the neighborhood of 30 tons per acre. It should be noted that the no action alternative would retain nearly 30 tons per acre of forest fuels on the ground, an amount that is much higher than this site ever had when it was in a savanna condition.

large woody material retention:

Not only does large woody material (LWM) on the forest floor contribute to nitrogen capture as mentioned above, but the various complex chemicals produced during their decomposition aid in creating and maintaining soil structure, as mentioned in the above discussion on soils. It should be noted, however, that large amounts of woody material are not needed at all times on a site to provide for its productivity. In fire regimes that include frequent underburning (such as the landscape within which this project occurs) or reburning after catastrophic fire, these types of structures are often removed from a site for prolonged periods of time and sometimes over large areas of the landscape (USDA, 1995; Kauffman, 1990; Agee, 1990). None-the-less, sites which experience such events can still be very productive, as there are several other mechanisms by which nutrient levels and soil structure are maintained. Very frequent and high intensity burning could, however, eventually lead to a decrease in site productivity (Kraemer and Hermann, 1979).

Long-term woody material input to the forest floor would be provided by the retained trees.

mycorrhizal communities:

Mycorrhizae are composed of a number of fungi species which are symbiotic with woody plants, especially coniferous trees. While conifers can survive without these fungi, the fungis' association with tree roots provides for better nutrient and water availability for the trees, and ultimately enhances the productivity of conifer sites (DeYoe and Kromack, 1983). Lynch and Bragg (1985) indicate that mycorrhizae also create compounds important in maintaining a permeable soil structure, another component of site productivity. While this relationship is symbiotic (the trees provide the fungi with complex sugars in exchange for their nutrient and water collection functions), these fungal species can persist on dead conifer roots for several years, and they also live on hardwood trees and shrubs that often survive fire and harvest (Perry, et al., 1989). Hence, as long as live conifer trees remain on site the existing mycorrhizal community will persist as it colonizes new young tree roots, though some change in mycorrhizal species composition can be expected (Perry et al., 1989; Mason and Walker, 1993) as the soil environment is subtly changed by savanna restoration. Perry at al. (1989) indicate the species composition of mycorrhizal communities is not especially important, as long as the function of that community is maintained. The proposed understory density reduction will not have an appreciable effect on the mycorrhizal communities in these forests.

The mycorrhizae communities on this site at this time are probably somewhat different in species composition than they were 100 years ago, but more or less the same species are likely still present in some amount since the same species of trees, forbs, and grasses still occur on the site. It is expected that a reduction of tree density and an increase in grass coverage would return the mycorrhizal community to something similar to what it used to be when the site was originally a savanna.

nitrogen fixers:

As previously mentioned, certain early successional plant species play a very important role in replenishing nitrogen levels after catastrophic fire or regeneration harvest. In this area, this vegetation is primarily Ceanothus integerrimus, or deer brush, a shrub in the buckthorn family that typically occupies drier, south-facing sites in the middle elevation western Cascades. (Zavitkovski and Newton, 1968; Klock and Grier, 1979; Warning and Franklin, 1979). Kraemer and Hermann (1979) found that nitrogen fixation replaces nitrogen lost by broadcast burning within 25 years.

The nitrogen fixation provided by late-successional arboreal lichens will be decreased since savanna restoration will reduce the extent of tree crowns and change crown microsite conditions in these stands. At least one species of lupine (another known nitrogen-fixing genus) currently is present on these sites, and is expected to expand in response to tree removal.

Nitrogen fixation by bacteria within old, large woody debris will also be reduced to that amount within the prescribed large woody debris retention. These sites historically had naturally low amounts of this material. The amount of nitrogen fixed by within-log bacteria is also small and a reduction in this type of habitat will not materially affect the total nutrient capital of the sites in question. Increased big game browsing on the resultant lush understory vegetation may also result in increased nitrogen import to these sites as animals deficate nitrogen-rich waste from food eaten elsewhere.

M. Long-term Management

It should be noted here in case it is not intuitively apparent from the preceding discussions that it will take a considerable amount of time for the restored savanna to look like it did 100 years ago. Most of the large, open-grown oaks have died, and it will take several centuries for young oak trees to develop the full structure and function that the original savanna trees had.

Whatever alternative is selected for implementation (assuming it is an action alternative) long-term maintenance of the restored savanna will need to provide for some mechanism to prevent large scale tree invasion such as occurred on the site from 90 to 120 years ago. There are several ways to prevent young trees from become too well established, including manual removal and mowing of the grassland, but by far the most ecologically appropriate and most efficient method is through the judicious use of prescribed fire. It should be noted that we would not want to be too efficient in tree exclusion, as the occasional young tree needs to become established to eventually replace the mature savanna trees as they eventually succumb to old age.

Prescribed underburning is by far the preferred methods to maintain the open nature of this restored savanna for several reasons. Underburning is far more efficient and cost effective than either manual removal or mowing, and confers a host of ecological benefits (such as fuel reduction and nutrient cycling) that would not accrue under the later methods, and underburning should favor native over non-native vegetation. Mowing also could cause soil and residual tree damage.

The Jim's Creek planning area is just one moderately unique portion of the larger mixed conifer forest type. The results of this first, tentative restoration effort may indicate whether additional restoration of this forest type would be successful and desirable in the future. In this sense, the Jim's Creek savanna restoration project represents adaptive management at its best. Vegetative treatments will be implemented, their results will be evaluated, and based upon that evaluation, additional areas may be treated in similar fashion, or the treatments may be modified if the desired future condition was not fully achieved by the initial treatments

N. Managing Competing and Unwanted Vegetation

Some amount of concern has been expressed by people interested and involved in oak forest type restoration for the potential of the proposed actions to result in the invasion and spread of non-native plants. The stands proposed for excess tree removal do not contain any vegetation that is unwanted, other than the trees prescribed for removal. Luckily there are virtually none of the more aggressive and particularly egregious woody noxious weeds such as Himalayan blackberry and Scots broom on the lands proposed for tree density reduction. This condition is one of the things that make this restoration project so attractive, different, and more likely to be completely successful than others which have occurred in vegetation types containing a high level of woody non-native plants. Since there are no such plants within the proposed activity areas, there are no seed sources, either from existing plants or stored in the soil profile. Several species of noxious weeds do occur along the roads in and adjacent to these stands, and to some extent in the plantation where certain restoration activities are also proposed. These non-native plants consist of a number of scattered, small populations of noxious weeds such as Saint Johnswort, typically along the road system and portions of the old harvest units, and various non-native annual grasses in the meadows and plantations.

The proposed tree removal could create conditions conducive to the spread of noxious weeds, as most of the species of concern seem to spread mostly in open areas, and the harvest will create open areas with a certain amount of soil disturbance on all sites. Indeed, the conditions we need to create for the restoration of native plants such as Oregon white oak and California fescue bunchgrass are the same conditions to which noxious pants would respond well to. To avoid introduction, spreading, or increasing noxious, non-native species, all heavy equipment brought into the area should be thoroughly washed before entering Federal lands, and areas of disturbed soil associated with landings and road maintenance should be seeded with appropriate native plant species. Diligent monitoring should also be conducted to identify any developing noxious weed invasion. The Botany Report for this project contains a more in-depth discussion and set of prescriptions relating to prevention of noxious weed spread.

In a real sense the main unwanted vegetative component in this project is Douglas-fir, and the entire project is designed to significantly reduce its density and function in this particular environment.

O. Monitoring and Evaluation

The following activities and conditions relating to silvicultural issues should be considered for future review and project compliance monitoring:

Implementation monitoring:

Monitoring item	Timing	Thresholds
tree retention levels	Immediately after project layout and immediately after project implementation	Average of 18 per acre
Retained tree mortality (the need to create snags)	Five years after implementation	Less than two trees per acre
Oak seedling survival	Two years after planting	Four per acre
need for seedling protection or mulching	One year after planting	Greater than 30 percent of seedling experiencing vegetative competition or big game browse damage

Effectiveness monitoring :

Monitoring item	Timing	Thresholds
degree of mortality of oaks after prescribed fire (Mutton Meadow and Jim's Creek area	One to two months after prescribed fire	More than 20 per cent mortality
Grass cover in excess tree removal areas	two years after planting	Less than 40 percent of area covered by native grasses
Performance of alternative oak reforestation methods (containerized seedlings vs direct seeding).	Four years after oak reforestation completed	Supplemental oak planting, using the most successful method, should be done if less than ten oaks per acre are living and vigorous three years after planting
grass response in plantation underburns	One year after underburns occur	Less than 50 percent ground coverage
Noxious weed occurrence	One year after slash burning is completed	New species occurring on site More than 5% coverage

Validation monitoring:

Monitoring item	Timing
Amount of natural oak revegetation	Five years after implementation

III. Silvics Analysis

A. Alternative Effects

The following discussions detail the direct, indirect, and cumulative effects of the above, fully developed and analyzed alternatives. Direct effects are those created immediately by any of the proposed actions. Indirect effects are also caused by the implementation of the proposed actions, but may occur later in time or away from the location of those actions. Cumulative effects are the sum of all past, current, and reasonably foreseeable future actions related to a given issue or concern. Cumulative effects should be qualified by indicating over what area and what period of time those effects are measured or estimated. Reasonably foreseeable future actions are defined as those proposals that are specific enough to be able to meaningfully estimate what their effects may be. Usually, such projects would be those for which a decision has been officially made but not yet implemented, or which have been formally proposed and have at least gone through the NEPA scoping process.

A simple example of how these three types of effects differ would be (given, say, an issue of old-growth habitat availability) direct effects: amount of old-growth proposed for harvest; indirect effects: amount of old-growth forest that may be damaged or destroyed by windthrow at the edge of a harvest unit once the initial harvest is completed; and cumulative effects, percentage of old-growth harvested within a watershed over the last 100 years.

Maintenance of Biodiversity Effects (the third significant issue)

For this issue the evaluation criteria relating to silvicultural matters include: acres of savanna/open forest restored, and the probability (or efficacy) of short-term restoration success or risk of retained tree mortality. The rationale behind the use of an acreage restored figure is simply that, for the purposes of biodiversity maintenance in a 25,000 acre landscape that has essentially lost all its open forest and oak/pine habitat, more habitat fully and successfully restored is better than less. In relation to the amount of open forest that has been lost through the development of a dense, young tree canopy, none of the alternatives have an especially large or meaningful effect from a landscape perspective. As discussed in the project's Purpose and Need statement, the implementation of any of the alternatives is a tentative first step to see if the proposed methods are successful and may be applied to larger areas in the future, depending upon the degree of actual environmental effects. The probability of restoration success, or efficacy, is addressed after the amount of habitat restoration. This estimation of restoration efficacy responds to public concerns that there could be some negative consequences if an area is restored to it initial stand density in a short period of time.

Alternative A – proposed action: This alternative would fully restore about 241 acres of savanna or open forest.

Alternative B – no action: This alternative would not accomplish any restoration and so would not provide for any biodiversity maintenance benefits.

Alternative C – staged removal: This alternative would not accomplish full restoration on the 171 treatment acres. In this area, it is doubtful that enough growing space would be available to provide for vigorous regeneration and growth of either Oregon white oak or ponderosa pine, therefore, the restoration would not be complete. Subsequent removal of the second group of excess trees would further reduce restoration effects by potentially damaging or destroying the bunchgrass and young oak saplings that do developed after the initial treatment.

Alternative D– multiple methods: This alternative would accomplish full restoration on the 65 acres of 5 to 15 percent retention, and partial restoration on the 49 acres of 20 to 25 percent retention. On the later piece of ground, it is doubtful that enough growing space would be available to provide for vigorous regeneration and growth of either Oregon white oak or ponderosa pine. On the 41 acres of oak release, restoration options would be partially retained in that the few remaining oaks would persist on the site for a longer period of time, but that area would still not provide a fully functioning savanna environment, and ponderosa pine would continue to drop out of the stands. Subsequent removal of the second group of excess trees would further reduce restoration effects by potentially damaging or destroying the bunchgrass and young oak saplings that do developed after the initial treatment.

Alternative E – full restoration: This alternative would fully restore about 455 acres of savanna or open forest.

Alternative Efficacy Discussion

The following discussion on alternative efficacy addresses potential uncertainty for the effectiveness or success of savanna restoration and accomplishment of Biodiversity objectives. This discussion will provide the rationale behind the EA's disclosure of the effects related to the biodiversity issue by addressing general concerns as to whether this project will be successful. As may be expected, this discussion will be qualitative rather than quantitative; there is no meaningful way to quantify probabilities relating to restoration success since so little has been done and studies of restoration efforts have been limited and of short duration. But logic and rational will be provided regarding my professional opinion of the short-term efficacy of savanna restoration for each alternative.

While savanna restoration could, in theory, be accomplished in the long-term by simply starting from scratch after a regeneration harvest, there is a short-term need to the maintain some functioning open forest on this landscape due to the nearly total lack of this vegetation type and important habitat (resulting from 100 years of fire exclusion), and to maintain a genetic continuity into the future. In the short-term, we need to maintain whatever remnant stand structure and species that still exist, as well as to set the stage for the ultimate development of the original savanna conditions. As an example, though it will take several hundred years to grow a savanna-form oak, in the short-term we need to provide environmental conditions such that young oak can grow vigorously and ultimately develop the massive, spreading crowned savanna oak.

<u>Concern for Success</u>

A number of people have, over the years this project has been discussed and developed, expressed various concerns about moving too fast in this restoration effort (see the Public Involvement section of the Analysis File for this project), all of which ultimately relate to whether or not the proposed actions would be successful in restoring the original savanna conditions. To more clearly articulate these concerns, the following quotes are listed. These comments came from public meetings, field trips, and occasionally email correspondence, responding to various stages of project development:

"Consider a 'phased nudging' rather than a single treatment."

"We should maintain our options – be cautious and weigh immediate benefits against long-term objectives."

"We can't restore the original vegetation quickly" (in term of age and structure).

We need to exercise caution and humility – we do not have much experience in savanna restoration"

"these stands took more than 100 years to become in their current conditions, changing them in a single treatment could have unexpected consequences that may have insufficient capital (in the form of mature trees) to overcome."……… "we remain concerned about the sudden change called for in this project…take a more cautious approach in the logging prescriptions so the system is not overly shocked and there is enough natural capital in the form of mature trees to respond to any stochastic events or other disturbance vectors."

"I'd suggest a phased approach to restoration in which we maintain all the remaining ponderosa pine, big Dougs, oak, release some of the smaller understory Dougs to be future dominant trees, and plan for frequent prescribed fire to encourage ponderosa pine."

"Be cautious about creating drastic changes in the next 20 years – the transition to a more open forest should be a long-term one, but if something isn't done soon we will lose all the oak and the pine."

As best I can tell, all the above concerns boil down to a fear that retained vegetation will respond negatively to release and/or that new, desired vegetation will not develop to an appropriate extent. All the above being said, we have also received at least as many comments supporting the proposed action and advocating the need to expand the area proposed for treatment ("we should ask why we should go slowly; there is a great urgency to act" and "A 600 acre restoration may be too small. The effort should be expanded to the landscape level"). At the same time, people's feelings about savanna restoration seem to be conflicted; note the last italicized quote above, where the speaker suggests caution and deliberateness, but in the same sentence expressed a need for quick action!

I have asked the people commenting on the need to go slow or do a phased approach (which translates to me as a staged removal of excess trees) for more specificity regarding their concerns. None have been able to provide any specific explanation, information, or research literature citations which support the feeling that removal of all the excess trees at one time might somehow cause excessive mortality of the retained trees, aside from a general angst regarding the spread of noxious weeds (see above for a discussion of noxious weed presence and spread potential). Indeed, the very plants we want to encourage (specifically, bunchgrass, ponderosa pine, and Oregon white oak) require some drastic environmental changes for them to regenerate and grow vigorously. The fact that noxious weeds respond to the same conditions needed for vigorous growth of the desired vegetation is not a reason to avoid creation of those favorable conditions, but rather tells us we need to mitigate the potential for bringing the noxious weeds into the area in the first place, or in the worst case, be prepared to do some early and preemptive eradication should they indeed appear.

While there are phenomenon such as thinning shock (which does not typically kill a tree) and sun scald (which can cause mortality), I see no reasons why, given the species we are trying to release, that such concerns be applied to the proposed action. Sunscald generally occurs only to trees that are shade tolerant when their stems are exposed to full sunlight suddenly (such as grand fir). Few such species occur in the Jim's Creek landscape. We have some very good examples in this planning area that the trees we are trying to release can and do respond well to such a release.

It is true that no long-term studies on Oregon white oak's response to release have been done (Harrington and Kern, 2002), but much study has occurred on eastern white oak (*Quercus alba*), which is an ecologically related species (Harrington and Kallas, 2002) that has been found to respond favorably to release (Harrington and Kallas, 2002, contains numerous references to various Q. alba response studies). Harrington, et al. (2002 and 2004) have initiated a study of the effects of release on Oregon white oak. Though this is a long-term study, preliminary results suggest that even the most complete and abrupt release results in a positive response for the released trees and no immediate mortality was noticed. Indeed, Devine and Harrington (2004) have already documented an increase in epicormic branching in fully released oaks, a greater response than for partially released trees. Epicormic branching is an important means through which a formerly suppressed oak can rebuild its crown volume and once again become a vigorous and reproductive tree.

Ponderosa pine response to release has been even more studied. It is a well known fact based upon decades of selection harvest management that ponderosa pine responds positively to release (Barrett, 1963, 1969, and 1979). Additionally, a study by Fule, et. al. (2001), though conducted in an ecosystem somewhat different than that occurring in the Jim's Creek area, found full restoration treatment in a ponderosa pine stand (as in immediate return to pre-settlement densities) protected the stand from crown fire better, without any significant change in native understory vegetation, than did minimal thinning or burning alone. But in the Jim's Creek area we do not need to rely on research done on distant sites to establish that pine do well with release from adjacent conifer competition, as past partial harvest treatments in and around the area have shown, at minimum, that ponderosa pine generally do not die or respond negatively when adjacent trees are cut.

It is a well accepted concept in silviculture science that trees respond to release from competitors, and I know of no literature that documents a negative response to release in terms of general tree vigor or increase in insect pest infestations or fungal infections, as long as removal of competing trees is done in a careful manner (e.g. the soil is not compacted, leave trees are not unduly damaged, and slash that could provide for a build up of pathogen populations is adequately and properly disposed of). Nor do Harrington and Kern (2002). We can certainly expect continued individual tree mortality in the older pine given their age and the stresses they have been subjected to by the competing 100 year old understory, but this mortality source is likely to affect less than one tree per acre of the retained trees. Therefore, I find the concerns regarding negative responses of trees to release to be unfounded and in opposition to successful restoration. Concerns that rapid release of legacy trees may cause some sort of ill-health can be readily dismissed.

The only realistic natural threat to the retained trees which could potentially affect many or most of the trees that I can conceive of is wind throw, and we have good local examples indicating that wide-spread incidence of windthrow is not especially likely. These examples are the two shelterwood harvested stands which retained from 15 to 25 trees per acre. While these stands have seen some windthrow related mortality and some of the older retained pine have continued to succumb to old age and /or bark beetles attack, from my measurements and observations, I estimate that less than 1.5 retained trees per acre have died in the 20 years since they were exposed by the harvest.

Another potential source of mortality in retained trees could be the prescribed underburn to reduce logging generated fuels. This potential is, in my mind, the most likely to result in retained tree mortality, but can be mitigated through slash pull back from trees with slash accumulation too close to the bole, use of pile burning rather than broadcast burning, and the season of burn. There is also a concern for the temporal effects of burning, be it for the disposal of logging generated slash or more maintenance of the open forest and grassy ground vegetation. Any burning that occurs when the plants are activly growing, be they the aerial or below ground portions, could potentially cause considerable mortality. Proper application of prescribed fire during periods when plants are known to be more or less completely dormant (in this area from September to early March), would for the most part remove this concern. See the discussion on prescribed fuels reduction above for more details.

I feel the proposed 20 tree per acre retention is actually too high to immediately achieve full restoration benefits, but that degree of retention does give us a buffer to account for more than the expected amount of mortality, and also provides the future option to create snags for wildlife habitat if the expected mortality does not occur.

It is not at all clear to this prescription writer why some people have such a tentative view on the efficacy of possible savanna restoration techniques, especially given the several examples we have within and immediately adjacent to the planning area where certain and various savanna characteristics have successfully been reestablished even thought there was no conscious intent to do that at the time the activities were implemented. Here I speak specifically of the development of a bunchgrass understory and oaks regeneration in the four plantations. The only speculation I can offer is that many of these people have had experience in restoring Oregon white oak /grass vegetation types in the Willamette Valley, in areas that have been significantly disturbed over more than a century by grazing, machinery travel, and introduction of a host of noxious woody and herbaceous plants. These conditions do not apply to the Jim's Creek planning area (see the discussion above on Managing Competing and Unwanted Vegetation).

My main concerns for the efficacy of this proposed savanna restoration have little to do with the number of trees retained (so long as we take enough trees off the site to provide for reestablishment of native understory vegetation such as bunchgrass, camas and Oregon white oak) and the degree of possible mortality. The things we really do not have a good idea about are how to get a relatively dense bunchgrass understory to develop, and maybe even more importantly, when to reintroduce periodic, landscape-scale prescribed fire to the sites without killing newly regenerated oaks back to ground level with each fire (or in other words, how large do oak stems need to be before they can survive the historical, fall burning?). Though these are important questions, small test projects have been started (as in the burning which has already occurred in near by Mutton Meadow and in the larger pine plantation in the Jim's Creek project area; Bailey 2005) to help us learn how to best encourage bunchgrass establishment and provide for oak survival of prescribed fire. Additionally, we have the examples of the existing plantations in an around the Jim's Creek area where the native bunchgrass and Oregon white oak have successfully returned to the sites with little conscious management intervention, other than opening up the sites to sunlight.

<u>Staged Removal of Excess Trees</u>

A staged removal of trees on a limited portion of this landscape was considered in the analysis (see Alternatives C and D above) to address the general concern for retained tree mortality. This alternative was ultimately not selected for implementation because no specific reason to do such a staged removal could be identified, and two entries into these stands present several problems. Multiple entries provide multiple chances of introducing non-native plant species into the area; a second entry would potentially damage regenerating oak, pine, and bunchgrass due to mechanical damage and fire damage; and multiple tree removal entries would also be less economically viable and efficient, or at least generate less money from the sale of trees due to incurring two or more sets of mobilizations costs. In fact the Financial Analysis prepared for this project (contained in the Analysis File) shows that the second entries, because they would be removing fewer trees, would be a below cost operation (meaning the cost of administration and labor would exceed the value of the trees being removed). This last reality is of particular concern in that one of the primary objectives of this proposal is restoration of historic conditions and the money generated by the sale of excess trees is to be used to fund future restoration activities in and around the Jim's Creek project area.

If we do a staged or phased entry because we are not sure that a single entry will be successful, how long do we wait before we determine whether the staged entry worked or had acceptable effects? If we ultimately decide it did not meet all our goals, then we need to remove the remainder of the excess trees according to the desired future condition. How long after that second entry do we wait to know whether it worked or not? And if the second entry did then work, we still would not know if a single entry would work better. While all these iterations are done to be absolutely sure we can predict their outcome, more pine and oak would be succumbing to suppression mortality throughout the mixed conifer forest type. The bottom line is, we have only about a 50 year window within which to accomplish restoration across the larger mixed conifer landscape. After that there will be few if any legacy trees remaining to facilitate this restoration, and upon whose genetic legacy we can rely. The steps we take in the next decade need to be bold, least we lose this landscape level restoration opportunity. If the selected alternative turns out to be a disaster (which is quite unlikely given the performance of past management actions in this area) then we have created a large opening on only a small percentage of the mixed conifer landscape (from one quarter to less than two percent), in addition to learning a valuable lesson in restoration.

Amount of Savanna Restored

One aspect of alternative efficacy is the amount of ground treated. Since we cannot say with absolute certainty that our efforts will be successful, some suggest a smaller, experimentally-sized treatment should be tested first. In point of fact, this proposal is indeed a very tentative first step. Though several hundred acres may seem to be a large area, it is less than two percent of the original, more open mixed conifer forest type. If we have an objective to restore the entire mixed conifer type, and we take action on only 400 acres every five years (giving us a small amount of time to be sure the latest iteration was successful), it would take 300 years to restore the entire forest type. It bears remembering that we are within a 25,000 acres landscape of unique forest type, and very small, tentative actions are inherently outside the scale of that landscape. In that time all the legacy pine would have long been dead.

I have prescribed the retention of thirty percent more trees than the original savanna had (an average of 20 larger trees per acre, rather than the original 14 per acre) precisely to account for potential, unpredictable mortality. If these trees do not succumb to natural mortality they should be killed in the future (see the snag creation discussion above) to assure that adequate growing space for Oregon white oaks will exist. If the proposed action or something very similar is selected for implementation, and is as effective as I believe it will be in initially restoring a semblance of a savanna, my recommendation to decision makers would be to implement a similar action on several thousand acres to prolong the life of as many legacy ponderosa pine as we can, without adversely affecting other resources.

Efficacy of Maintenance Underburning

Another aspect of alternative efficacy in relation to savanna restoration success is the likelihood that future periodic underburning will occur and be successful. Some have expressed concern that there will not be funding available in the future to accomplish this most important task. While this certainly could be true, it is a speculative concern and this report will assume that a decision made to restore this area would reflect people's interest in such restoration and that interest is likely to increase with time. One aspect of successful application of future prescribed fire is how efficient that application may be. If we do not place treatment units on the ground to make use of natural topographic breaks on which to stop fire, its use will be very expensive. Also, if we have a number of smaller treatment units, each one different enough to need a different timing or extent of fire application, such future use will be expensive if an entire slope cannot be treated at once and fire has to be excluded from adjacent treatment areas on different burning schedule. Such high expenses could make future maintenance burning less likely to occur. A comprehensive restoration strategy such as that proposed in Alternative E would provide for a more feasible and less costly maintenance burning regime.

Restoration Efficacy Effects:

Alternative A – proposed action: This alternative has a high probability for restoration success, since there is a low likelihood that a significant number of retained trees will die, and full removal of excess trees at one time (and future snag creation in the extra retained trees) would provide for adequate growing space for important components of the savanna such as open-grown oaks, a dense and vigorous bunchgrass ground vegetation layer, and ponderosa pine regeneration. Under this alternative, there would be no chance for damage to recovering and restored vegetation from future removal of excess trees and the subsequent need for fuels reduction. The one detriment to this alternative in terms of restoration success would be that only half the area analyzed would be treated, thereby inflicting the effects of the No Action Alternative on the 200 acres of the planning area that would remain unrestored.

Alternative B – no action: This alternative presents no probability for restoration success since nothing would be done to prevent continued mortality of legacy vegetation, nor would it provide any growing space for development of replacement vegetation. Indeed, implementation of this alternative would eventually result in a nearly pure stand of middle-age Douglas-fir, and could present the possibility that the entire forest, including all remaining legacy trees, be entirely lost if the area ever experienced a late-season wildfire.

Alternative C – staged removal: This alternative provides a low to moderate probability for restoration success since it would retain almost twice the number of trees on the site as would Alternatives A and E, and generally would not provide adequate growing space for important components of the savanna such as open-grown oaks, a dense and vigorous bunchgrass ground vegetation layer, and ponderosa pine regeneration. Under this alternative, there would be a significant chance for damage to recovering and restored vegetation from future removal of excess trees and the subsequent need for slash removal. Even if the initial removal is deemed a success and the remaining trees are removed in a second entry, a period of time would elapse and legacy trees would continue to succumb to suppression and old-age morality on the acreage treated, and by inflicting the effects of the No Action Alternative on the 250 acres of the planning area that would remain untreated.

Alternative D– multiple methods: This alternative has a high probability for restoration success on the 65 acres of complete excess tree removal, since there is a low likelihood that a significant number of retained trees will die, and full removal of excess trees at one time (and future snag creation in the extra retained trees) would provide for adequate growing space for important components of the savanna such as open-grown oaks, a dense and vigorous bunchgrass ground vegetation layer, and ponderosa pine regeneration. In the above treatment block, there would be no chance for damage to recovering and restored vegetation from future removal of excess trees and the subsequent need for slash removal.

On the 49 acre prescribed for 20 to 25 percent retention, this alternative would provide a low to moderate probability for restoration success since it would generally not provide adequate growing space in that area for important components of the savanna such as open-grown oaks, a dense and vigorous bunchgrass ground vegetation layer, and ponderosa pine regeneration. Under this alternative, there would be a significant chance for damage to recovering and restored vegetation from future removal of excess trees and the subsequent need for slash removal. Even if the initial removal is deemed a success and the remaining trees are removed in a second entry, a period of time would have elapsed and legacy trees would continue to succumb to suppression and old-age morality on the acreage treated.

On the 41 acres prescribed for oak release restoration potential, in terms of maintenance of existing oaks, would remain, but no restoration of other important vegetative structures, such as oak and pine regeneration and bunchgrass reestablishment, would occur.

Additionally, another detriment to this alternative in terms of restoration success would be that less than half the area analyzed would be treated, thereby inflicting the effects of the No Action Alternative on the 250 acres of the planning area that would remain untreated. Another problem this alternative would present relates to the small treatment areas and the inherent difficulty in treating small areas with differing maintenance underburning prescriptions.

Alternative E – full restoration: This alternative has a high probability for restoration success, since there is a low likelihood that a significant number of retained trees would die, and full removal of excess trees at one time (and future snag creation in the extra retained trees) would provide for adequate growing space for important components of the savanna such as open-grown oaks, a dense and vigorous bunchgrass ground vegetation layer, and ponderosa pine regeneration. Under this alternative, there would be no chance for damage to recovering and restored vegetation from future removal of excess trees and the subsequent need for slash removal. Since this alternative would restore all the available acres in the planning area (while maintaining various other resource values, such as within Class II riparian reserves), it presents the best restoration scenario of any of the alternatives.

Time Frame:
Full restoration of pre-settlement conditions will take several centuries; it will take at least 200 years to replace the large, open-grown oak that have been shaded out by the 100 year old cohort of Douglas-fir. Judging from the natural recovery of the native bunchgrass in the four plantations, and considering that we are prescribing to broadcast grass seed to assure success, it would probably take no more than about five years to reestablish a dense cover of native ground vegetation. The pre-settlement frequency fire regime should be reestablished in 10 to 12 years, after oak seedlings become established.

Cumulative Effects:

The Forest Service Handbook (FSH 1909.15 Chapter 10 15.1) requires consideration of cumulative impacts in an environmental analysis. Cumulative effects are defined as the impacts on the environment resulting from incremental effects of the action when added to other past, present, or reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The most meaningful area over which to look at restoration of biodiversity and specifically restoration of the once more open forest type would be the Mixed Conifer forest type mentioned in the Vegetation Conditions section of this report. It is that mixed conifer landscape that has change considerably over the years. In terms of general vegetative change cumulative effects within this forest type, the entire 25,000 acre area has become more dense than historic conditions as a result of fire suppression and/or the cessation of a prescribed fire regime. In the past 40 or fifty years, about 12, 240 acres (or about 48 percent) of the mixed conifer forest type has been harvested with even-aged, regeneration techniques; about 7,000 acres of that amount occurred on private forest lands. Some of those harvested areas experienced some degree of restoration in the sense that native grass and oaks have revegetated in some young stands. Such reestablishment of native ground and hardwood vegetation in harvested areas has been and continues to be fairly ephemeral as these young stands continue to grow and close their canopy. About 3539 acres (14 percent) of the mixed conifer type is now composed of young managed stands old enough (from 20 to 40 years) to have a closed canopy where the native ground vegetation and hardwood trees have been more or less shaded out of those managed stands.

There have been no past actions (within the last 20 years) and there are no current actions (other than this one) which have attempted to restore savanna or open mixed conifer forest vegetation in this watershed. There has been some attempt, both in the Jim's Creek project area and within the mixed conifer forest type, to maintain meadows and other open forest types, such as Big Pine Openings and Mutton Meadow, through the use of fire and some manual removal of encroaching trees. These efforts were moderately successful when they were initially done (as far as is known, none of this type of activity happened after 1985), but since no follow-up work was done, trees have since again invaded the areas where trees were encroaching upon meadows. Therefore, in terms of the amount of restoration done in order to address the maintenance of biodiversity issue, there are little to no cumulative effects in regard to this proposal.

At this time there are no reasonably foreseeable future actions that would add to the cumulative effects regarding maintenance of biodiversity. While the Jim's Creek restoration proposal is in part being made as a test treatment to determine if additional restoration of more open forest conditions within the Mixed Conifer forest type would be desirable, we do not know how many acres may be treated in the future to accomplish those goals, nor where those acres may be, nor even if such activities will even occur, until we see the results of this set of proposed actions. Therefore, it is impossible to assess the cumulative effects of future actions, since their extent and location is not reasonably foreseeable.

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. **Literature Cited**

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