A Silvicultural Prescription for High Priority Forest Management Areas

A Report Prepared for

The City of Ashland

by:

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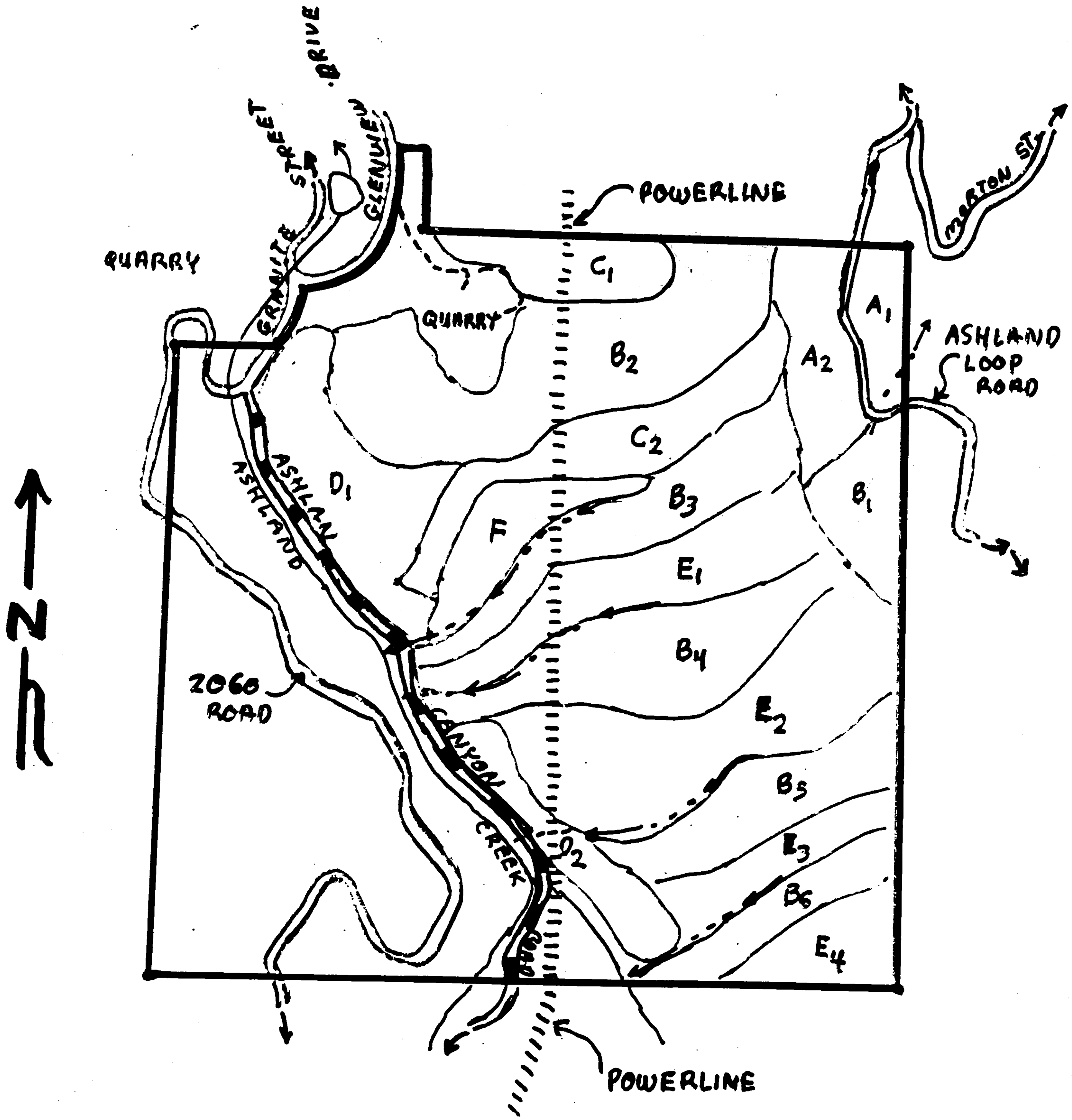
MANAGEMENT UNITS



prepared by: Marty Main
Small Woodland Services Inc
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Scale 1" = 330'

INTRODUCTION

Small Woodland Services, Inc. was commissioned by the City of Ashland to develop silvicultural prescriptions for an area prioritized for forest management activities in a previous assessment by the same company ("A Preliminary Assessment of Forest and Resource Management Priorities on City of Ashland Owned Lands," Small Woodland Services, October, 1995). Preliminary meetings with Pam Barlow and Keith Woodley of the City of Ashland suggested three primary objectives in the management of the above area as outlined in the Preliminary Assessment:

1. Protection of watershed values and maintenance of water quality and quantity for the City.
2. Maintenance and/or promotion of forest and ecosystem health.
3. Reduction in wildfire hazard and risk.

The Forest Plan for City of Ashland Forest Lands completed in May, 1992 by R.J. McCormick and Associates clearly spells out a general management for all the City-owned forest lands. It also provides a foundation on which this report rests. The management direction suggested in that plan is professional, sound, and fully deserves to be carefully adhered to. This report offers little new direction, but rather a more intense, site specific descriptions and analyses for one portion of the City ownership highly prioritized for management activity. Within the management area addressed by this report, it updates management direction slightly, based on changes that have resulted in the three-plus years since the McCormick plan was developed.

The McCormick Plan, on page 3 of Chapter 1, states,

> "In our judgement, created disturbance that emulates natural ecological processes must be reintroduced into the watersheds. If this does not occur, there is a very high risk of catastrophic wildfire and a rapid loss of old growth and other age classes through insects and disease."

This report fully concurs with that assessment and add that three years of time without "created disturbance" has substantiated and further aggravated the existing problems. Mortality of overstory conifers and other associated changes from insects has continued, if not escalated. Loss of overstory conifers ultimately contribute to soil instability as roots die and lose strength, contributing to decreased soil stability with potential negative impacts upon hydrologic realities in the watershed. Snag development, coupled with ongoing vegetative growth and subsequent increases in fuel loading in the last three year, has even further increased fire hazard and the chance for catastrophic wildfire. Reversing these trends of declining stand vigor and subsequent increased likelihood of stand mortality from either insects and/or wildfire seems even more urgent than three years ago. Without a proactive approach of implementing "created disturbance that emulates natural processes," catastrophic wildfire is clearly imperative, with a significant if not overwhelming decline of virtually *all* of the values so clearly associated with City-owned forestlands. Obviously, this type of wildfire could easily threaten significant portions of the City of Ashland itself.

This report makes recommendations for sound forest and resource management activities that emulate natural ecological processes and are designed to hopefully reverse these negative trends within the designated management area. These are recommendations only, and are not intended to offer immediate solutions to the complex silvicultural and forest management problems that exist both on a landscape level and within the designated management area. Forest ecosystems operate on much longer time frames than most human endeavors—and management activities designed to facilitate the above-stated objectives will only be successful if measured over longer time frames and larger scales of reference. Nonetheless, this report hopefully will provide the City of Ashland with enough information, analysis, and delineation of options and costs with which to begin making sound management decisions for the designated management area.

PHYSICAL DESCRIPTION OF MANAGEMENT AREA

A. General Description

Location: The management area addressed in this report is located in the lower, most northerly portion of the City of Ashland ownership within the Ashland Watershed. It is located primarily in a block comprising the southwest quarter and the bottom quarter of the northwest quarter of Section 16 of Township 39 South, Range 1 East. This management area is referred to as Parcels 4 and 5 (excluding the area west of the main canyon road) in the Ashland Forest Plan prepared by R. J. McCormick and Associates in May, 1992.

Acres: Approximately 105. (updated acres: 156)

Access: Access to the management area is limited. The main haul road on the east side of Ashland Creek forms most of the westerly boundary of the management area. Access to the northwest corner of the management is provided by an access road to an abandoned granite quarry. Ashland Loop Road provides limited access through the very northeastern corner of the management area. The large bulk of the management area is steep and has no vehicle access.

Topography: The management area is dominated by two primary topographical features: (1) a major ridgeline at 3,000 to 3,100 feet in the northeastern corner of the management area; and (2) the canyon bottom of Ashland Creek, at an elevation of 2,200 to 2,300 feet. The majority of the management area is located between these two topographical features. Topographical draws that run water only during major storm events drain southwesterly to westerly from the ridgeline down into Ashland Creek. Associated ridges are located between each of these topographical draws, creating opposing northerly/northwesterly and southerly/southwesterly aspects. A small portion of the management area (approximately 10 acres) is located on more easterly-northeasterly aspects on the east side of the major ridgeline. The riparian habitat along Ashland Creek itself is an important management area, but is not included in the descriptions and analyses in this report.

Precipitation: Annual precipitation has historically averaged 25 to 30 inches, although that amount has certainly decreased during the last decade of drought years (typically down to 50 to 75 percent of annual averages). Very little of that total falls as snow at the lower elevations typical of the management area. Perhaps more importantly, however, is the highly seasonal nature of that precipitation, with less than 15 percent of that total occurring during the seasonally dry period from May through September. This has important ecological implications for vegetation establishment and growth, and ultimately forest management decision-making.

Soils: Soils in the management area are derived from intrusive igneous rocks formed during the Jurassic Age, 145 to 164 million years ago. The resulting soils were formed largely from colluvium derived from these granitic parent materials. The coarse textured soils are moderately deep and well to excessively drained. The lack of cohesiveness allows these soils to be easily moved, particularly during major storm events when a high likelihood exists for sheet and gully erosion, as well as mass soil movements. Fortunately, rain on snow events are rare in the management area, but continued heavy rainfall in winter or intense events such as summer thunderstorms can cause considerable erosion, particularly on these steeper slopes. Road construction should be avoided whenever possible, as roads are primary sources of erosion and subsequent sediment inputs into the aquatic ecosystem. Maintenance and/or restoration of existing roads or other non-vegetated spots (i.e., quarries) is of high priority in these soils. The USDA Natural Conservation Service has mapped this entire area (see appendix) and has delineated two primary soil series or types: Tallowbox gravelly sandy loams on the steeper slopes and Shefflein loams on the gentler slopes, primarily on the major ridgetop location.

Vegetation: Vegetation in the management area is dominated by the Douglas-fir series—mixed conifer-hardwood woodlands with scattered brushfields on more southerly aspects. On more northerly aspects, the vegetation is dominated by stands of dense Douglas-fir, with lesser amounts of Pacific madrone. Forest vegetation on more southerly aspects has greater species diversity, with Douglas-fir, Ponderosa pine, Pacific madrone, and California black oak dominating, but also including less common sugar pine and incense cedar. Whiteleaf manzanita dominates scattered brushfields on these more southerly aspects, often forming dense, impenetrable stands and/or being found in association with other hardwoods (Pacific madrone, California black oak) or brush species (mountain mahogany, deerbrush ceanothus). Understory vegetation typically includes tall Oregon grape, poison oak, snowberry, oceanspray, honeysuckle, and various grasses and broadleaved herbs.

History: The degree of Native American use of the management area is unknown, although extensive use was probably unlikely. However, it is likely that Native American burning in the Rogue Valley commonly "escaped" to the forested regions such as in the management area, thereby affecting development of forest vegetation. The presence of several older age classes scattered around the management area (at least three) in the range of 125 to 200 years suggest repeated disturbance in that era, most likely related to fire events, either caused by lightning or indigenous peoples. Early Euro-American use of the area was also probably minimal. The Ashland Forest Plan (McCormick and Associates, 1992) indicates the establishment of the original Ashland Forest Reserve in 1893, which may or may not have included the management area but undoubtedly affected management and disturbance possibilities for the area. Large wildfires occurred in the management area in 1901 and 1910. The 1901 fire appears to have been rather severe, as it appears that only scattered older trees survived that fire. By 1902, the early beginnings of fire suppression and exclusion were instituted in the Ashland Watershed area. The 1910 fire burned quite vigorously and completely on northerly aspects (probably due to the fact that the 9-year-old vegetation that developed after the 1901 fire was primarily dense thickets of conifers, hardwoods, and/or brush—an extremely fire-prone vegetation type), but appears to have varied considerably in intensity on more southerly aspects. A ground-based logging (probably horses) of scattered timber, particularly on more southerly aspects, was completed in the late 1930s. A helicopter logging was completed in 1990, largely removing scattered pockets of dead, dying, and (perhaps) other mature overstory timber throughout the management area.

VEGETATIONAL COMMUNITY DEVELOPMENT PATTERNS IN THE LOWER ASHLAND WATERSHED

The successful management of a vegetation type (i.e., timber, grass, etc.) designed to achieve any particular set of objectives ultimately depends on an understanding of how that vegetation develops and why it exists in the given situation. This is particularly important in many places in southern Oregon because the vegetation has moved beyond the range of historic conditions and into a type that is under considerable stress.

Forest vegetation composition is continually and significantly determined by relatively constant environmental variables, such as elevation, aspect, annual rainfall, soil type and depth, and numerous other factors. Variations in these environmental variables can, in themselves, produce differences in site conditions. In southern Oregon, these environmental variables are generally most critical in the influences they have upon moisture availability for plants, as moisture is usually the limiting factor affecting plant survival and growth in most of southern Oregon, and particularly at lower elevations such as the management area upon which this report focuses.

Aspect is an important environmental variable because greater amounts of solar radiation on southerly aspects during long, dry summer months limits moisture availability much more so than on northerly aspects (with easterly and westerly slopes intermediate). Obvious changes in vegetation occur in the management area on opposing southerly and northerly aspects. Douglas-fir heavily dominates the more northerly aspects, while much more diverse species compositions occupy more southerly aspects, including not only Douglas-fir but also Ponderosa and sugar pine, mixed hardwoods, and abundant brush species, all species tolerant of harsh, droughty site conditions.

The amount and seasonality of precipitation is also obviously important for vegetation establishment and survival. In particular, the lack of precipitation during summer months greatly affects the type, quantity, and diversity of vegetation that can survive and prosper.

Variations in soil properties are particularly important determinants of vegetation on any given site. Highly productive forest soils in southern Oregon usually have the following characteristics.

- More than 36 inches deep, with a well developed layer of topsoil
- Medium-textured loams, with little or no heavy clays
- Well drained topsoil, with moisture holding subsoil
- Less than 35 percent coarse rock fragments
- No hardpans or impermeable layers near the soil surface

These types of productive soils are particularly capable of storing greater amounts of water, the critical limiting factor to vegetation survival and growth in southern Oregon. Shallow soils of 24 inches or less and/or containing high percentages of rock fragments are only capable of supporting plants with specific adaptations allowing for survival at low moisture availabilities. In addition, other structural, textural, or chemical properties of soils can additionally reduce moisture availability. Clays, for instance, have physical and chemical properties that bind water and make it much less available for most plants, particularly conifers. Other plants, however, have adaptations that allow them to survive and even thrive in these conditions. Oregon white oak is an example of a tree that can survive and even thrive in heavy clays and/or very shallow soils. Although it too can thrive in more productive soils, it cannot compete favorably with other trees that prefer these locations (conifers, Pacific madrone, etc.) and thus is seldom found.

Unlike the first two environmental variables (aspect, precipitation), however, soil types and particularly depths, although fairly constant over time, can be quite variable even within small areas in southern Oregon. This wide variety of soils in southern Oregon accounts in large part for the wide diversity of vegetation types, even within small areas.

In essence, each site contains given environmental characteristics (such as just described) that encourage (or discourage) certain types of vegetation. Existing plant species can potentially act as indicators for potential site productivity. A collective analysis of all of the species and relative comparisons in vigor and abundance between species can help determine the potential productivity of a given site—and whether the condition of existing vegetation is within the range of historic conditions.

Strictly looking at environmental site conditions, however, almost never fully explains why a given vegetational composition and structure exists on a site. Traditional theory in vegetational community development has suggested that vegetation moves through a relatively predictable series of steps (called plant succession) until an old growth, climax forest is reached. Carried to logical conclusion, this theory would suggest that, without human influence or other disturbance mechanisms, the forests of the Pacific Northwest would have been almost solely stable, old growth forests prior to the European settling of the area.

However, extensive research in recent years suggests a slightly different analysis. On the contrary, disturbance of various kinds had consistent and often profound impacts upon vegetation, producing a variety of vegetational structures across a landscape. These disturbances would include wind storms; ice storms; droughts and related mortality; insect and disease outbreaks; landslides; flooding and/or erosion from peak storm events; and, most importantly, fire (ignited by either lightning and/or Native Americans). Many of these disturbance events were synergistic—that is, they worked together to kill existing plants and return sites to the earlier stages of succession.

These two categories of site condition determinants (environmental site conditions, natural disturbance history), then, provide much of the explanation for existing condition of vegetation on a site if they are analyzed correctly. However, a third major determinant may be the most important of all—that of management history, particularly within the last 100 years.

Typical management history impacts include many that are commonly known—wild-fire, mining, logging, grazing, off-road vehicle use, and various other construction and recreational activities. Perhaps the impact with the greatest influence is one of the least known and understood—that of fire suppression and exclusion.

Prior to the European settling of southern Oregon, the primary natural disturbance mechanism in southern Oregon forest and range ecosystems was frequent, low intensity groundfire. These fires, ignited by Native Americans and/or lightning, ranged in frequency anywhere from 10 to 50 years for any one site in southern Oregon, depending on elevation, aspect, fuel and vegetation density, climate, and other fire-related variables. Fire frequencies prior to the disruption of natural fire cycles were estimated at 8 to 10 years in the interior valley zone and 15 to 20 years in the mixed conifer zone, both types that exist in the management area (Ashland Forest Plan, 1992). Ignited any time during the seasonally hot and dry fire season and often creeping through the woods all summer long, these fires seldom flared up into wildfires as we know today—primarily because they removed fuel accumulations, both dead and green, on a regular basis rather than allowing it to increase into the proportions we have today.

Since the turn of the century, however, the conscious choice was made to extinguish all fires quickly and thoroughly. This may have been due, at least in part, in response to increasing numbers of wildfires that were occurring as a result of the elimination of Native American burning, increased downed fuel and slash from increasing lumbering and other developmental activities, and purposeful creation of wildfire by those who desired more open landscapes (miners) and/or the earlier stages of succession (ranchers, for native pastures).

This human-induced impact (elimination of frequent low intensity fire) upon the forest ecosystems of southern Oregon (and most of the western U.S.) has been particularly important in terms of forest management because frequent, creeping, low-intensity ground fire accomplished the following forest management functions:

1. Periodically cleaned up the woods of dead and downed material as well as reducing the heavy over-stocking of brush and small conifers we see today. The result was greatly reduced fuel loadings and subsequent decreased likelihood, extent, and intensity of wildfire.

2. Periodically reduced stocking levels in the woods, leaving the larger (and usually more vigorous) dominant trees (with more protective bark) and releasing them from competition of the smaller saplings, poles, and brush killed in these light fires. Some smaller seedlings and saplings always escaped creeping, low-intensity groundfire that typically burns in a mosaic fashion. The dense, overstocked, and highly suppressed stands we have today were much less likely to occur when fire burned frequently at low intensities.

3. By maintaining a healthier, less crowded and more vigorous stand AND by reducing available habitat (downed slash), forest conditions were far less desirable

for significant increases of destructive insects. Fire, and smoke, also played a critical role in the control of many deleterious forest diseases that have subsequently increased dramatically.

4. Frequent light fire varied considerably in intensity as it crept through the woods. In response to this highly diverse and ever-changing impact, a greater variation in vegetation species, ages, and structures was maintained. This maintenance of high degrees of biodiversity is an important feature of healthy, resilient forest ecosystems. In the absence of fire, species composition has significantly changed, with shade tolerant species favored.

5. Frequent, low intensity fire maintained more open stand conditions that encouraged development and maintenance of larger, shade-intolerant species, most notably Ponderosa pine. In the absence of fire, species composition has significantly changed, with shade tolerant species favored. Throughout the Western United States, these now overstocked shade tolerant species have been severely impacted by numerous forest insects and diseases. In addition, in the absence of frequent fire, stump-sprouting hardwoods and brush species that typically grow quite slowly when initiated by seed, have become much more common, further impacting development and even survival of conifers.

6. Periodic ground fire provided an excellent seedbed (ash) for natural regeneration of conifers. In the absence of fire, duff accumulations on the forest floor often are too great to allow for establishment of many coniferous seedlings, most notably the pines.

7. Fire played a critical role in nutrient recycling, particularly in drier, moisture-limiting climates where decomposition can be very slow. Frequent, low-intensity fire recycled nutrients "locked-up" in above ground fuel (both dead and green) and provided a fresh flush of vigorous growth not only on conifers, but of all vegetation including those species critical for wildlife. In the absence of frequent, light fire, a greater percentage of total site nutrient capital has been shifted above ground, with the potential for dramatically increased nutrient loss given the greater likelihood of stand destruction through wildfire and/or excessive harvesting.

8. Frequent fire is suspected to have maintained a lower level of above-ground biomass than exists today after 60 to 80 years or more of fire exclusion. The increased transpirational demands of this additional vegetation has decreased the amount of water available as groundwater or as overland flow in streams and rivers, with subsequent impacts on the many competing users of water, including increasingly impacted fisheries and other aquatic resources.

Unfortunately, it is apparent today that we cannot prevent fire from occurring in the fire-prone forests of southern Oregon, particularly given ever-increasing fuel levels. It is more appropriate to think about managing the intensity of the fire, rather than the occurrence of fire—and such is certainly the case in this management area. The type of large-scale wildfire event typical today was rare and certainly of much smaller acreages and intensities prior to the era of fire exclusion.

Once initiated through fire exclusion practices, however, the pattern of infrequent but intense wildfire (as opposed to frequent fire of low intensity) tends to reinforce itself as the dense brushfields and stands of thick, juvenile conifers and stump-sprouting hardwoods (the earlier stages of succession) are much more prone to wildfire of larger scales and higher intensities. These vegetation conditions are common throughout the management area. Houses built up into these vegetation conditions (particularly along the northern property line of the management area) are at extreme risk in the event of wildfire.

It is very likely that other as-yet undetected ecological functions were performed by periodic low-intensity fire. However, in its absence, we currently have stands (even some stands that have never been harvested) throughout southern Oregon that are tremendously over-stocked, with a high proportion of individual trees and stands under significant stress. These stand conditions provide ideal conditions for rapid escalation of bark beetle populations, as bark beetles can sense and generally attack trees under severe cumulative stress. Other factors such as drought, disease, logging damage, soil compaction, and others add to cumulative stress, making trees that much more susceptible to insects. Fortunately, the negative effects of disease (very little dwarfmistletoe, root rots, or other diseases were found in the management area), logging damage and soil compaction were minimal in the management area.

Once a bark beetle gains entry to a weakened tree, it can chemically communicate this condition to others of its species, thereby causing a "mass attack" which kills trees outright. Usually, several species of beetles work synergistically to overcome individual tree's natural defenses (primarily excessive pitch production), with a different cadré of bark beetles restricted to their preferred tree species. Flat headed borers (Melanophila drummondi) and Douglas-fir beetles (Dendroctonus pseudotsuga) are causing the extensive mortality of Douglas-fir throughout the management area and immediate environs. An entirely different cadré of bark beetles, primarily western pine beetle (Dendroctonus brevicomis), mountain pine beetle (Dendroctonus ponderosa), and pine engraver beetles (Ips pini) are the primary destroyers of Ponderosa pine. When populations of these cadres of bark beetles explode, even healthy trees can be overcome and mass mortality can occur, such as occurred in Lithia Park several years ago.

Each beetle has its own particular biology, and knowledge of that biology is critical to the success of any forest management activity. For example, Douglas-fir beetle tends to concentrate its activities in Douglas-fir trees 10 to 12 inches diameter and larger. This is particularly unfortunate in the management area because this size class of Douglas-fir is the size of the preferred dominant trees that represent the future. Many of the preferred trees have been, and are being, killed by bark beetles, leaving only suppressed, poor quality understory trees. The opportunity for improving stand conditions through silvicultural activities is much reduced in this situation, and often not possible at all if mortality is significant enough—in essence, leaving no available silvicultural technique for trying to healthy stand on a site. Succeeding and increasing populations of Douglas-fir beetles in conjunction with flatheaded borers, then, can destroy the remainder of the Douglas-fir in the stand, such as occurred several years ago in Lithia Park, where virtually all of the Douglas-fir were destroyed.

Currently, all stages of this process can be found within the management area. Without a proactive attempt to reverse this process through silvicultural treatments, this process of tree and stand mortality will continue, with much greater amounts of mortality possible.

Preventing or reducing insect damage, then, primarily involves preventing individual tree stress, or in other words maintaining a healthy stand. Natural, creeping, low intensity fires helped accomplish this by maintaining reduced stand densities. Manual thinning to reduce stand densities and improve overall stand health and vigor simulates these thinning effects of low intensity fire.

Small diameter Douglas-fir slash created in these activities is not preferred habitat for Douglas-fir bark beetles, and thus is not a potential breeding site. However, the beetles that attack Ponderosa pine can increase their populations dramatically in green Ponderosa pine slash cut during the months of January through June or July. As many as 3 to 4 generations of pine engraver beetles can occur in one season in southern Oregon. For this reason, thinning and release treatments in Ponderosa pine forests should be restricted to autumn and early winter, unless the green pine slash can be immediately disposed of.

The failure to address the rapid population explosions of these various bark beetles is to insure the increasing demise of the existing stands of conifers, as well as significantly contributing to potential severe wildfire behavior.

SILVICULTURAL PLANNING—AN OVERVIEW

Ideally, any particular forest or woodland has been and is being managed within a specific, well thought-out silvicultural plan designed to match the site, its potentials for forest development, and the desires of the owner. In essence, silviculture is the professional process of trying to modify forest vegetation in such a way as to meet the objectives of the forest landowner. Unfortunately, it appears that very little, if any, silvicultural planning has occurred on City of Ashland owned lands in the Ashland Watershed. Certainly this has been the case on the portion of those lands addressed in this report. In fact, it appears that the only activity in the last 50 years in the management area has been a mortality/sanitation salvage helicopter sale conducted in 1990. Apparently, this was a rather sudden operation with little silvicultural planning—primarily an attempt to quickly retrieve volume in order to trade for retaining additional volume on a more visible parcel to the south.

In sound silvicultural planning, responsibility for development of the stand and associated vegetation must exist from stand initiation and continue through the life of the stand. Most of the management area is currently dominated by existing stands of mixed conifers and hardwoods. The primary silvicultural emphasis, then, should be on stand management, although stand initiation through planned reforestation activities may be necessary on understocked or unstocked portions of the management area (i.e., brushfields, patches of insect-killed conifer mortality, etc.).

Stand Management

Stand management generally refers to the process of planning for a development of stands of desired species, ages, sizes, and structures, to achieve a specific set of objectives. As a generalization, stand management planning that attempts to create stand conditions that reflect the range of historic conditions is highly desirable. These types of stands will be better able to respond to the natural processes and functions that occur in healthy forest conditions. It is suspected that the conditions of the existing stands in the management area addressed by this report are probably well outside the range of historic conditions and, thus, more susceptible to considerable damage from otherwise natural processes such as fire, insects, disease, and others.

In sound silvicultural planning, stands are managed through periodic removals of growing stock, much as fire did prior to Euro-American settlement. These removals can be either commercial or pre-commercial in nature. In this relatively classical description of forest management, commercial harvesting can be utilized to produce even-aged stands using clearcut, shelterwood, or seed-tree harvest methods; or uneven aged stands using group selection, single-tree selection, or other continuous canopy methods. Unexpected mortality is retrieved in mortality salvage timber sales, while sanitation salvage sales remove diseased, deformed, defective, or otherwise poor quality trees. Following harvest, regeneration (if needed) is planned for using either natural seedfall or planting of conifers, or a combination of the two. Trees destroyed by wildfire, disease, insects, windthrow, or other disturbance events are usually harvested, if possible, and the areas immediately replanted with conifers. Developing stands are carefully managed to assure optimal stocking levels of desired species, as well as to attain other multiple resource objectives. Pre-commercial thinning and release treatments are used to accomplish these objectives in younger stands. In stands with merchantable size classes, intermediate harvests, such as commercial thins, maintain appropriate stand densities to meet management objectives.

In the management area addressed by this report, the second growth stands are considerably overdense and could obviously benefit from thinning and release activities designed to reduce stand densities. These "stand improvement" type of entries, either commercial and/or pre-commercial in nature, can accomplish seven important objectives:

1. By reducing the number of trees competing for a finite amount of nutrients, light, space, and principally water, a healthier, more vigorous remaining stand will result.

2. Individual trees, under more optimal densities and subsequently of greater health and vigor, will be better prepared to withstand attacks from deleterious insects or diseases.

3. By thinning and removing a portion of the above-ground fuel, both the likelihood of ignition, as well as the intensity and the rate of spread of wildfire will be significantly reduced, particularly if the resulting slash is also utilized and/or removed.

4. Volume growth will be redistributed onto fewer, healthier, more valuable trees. Growth rates will improve dramatically on these released trees. Larger trees will be developed much sooner subsequently decreasing logging costs (less trees to make the same volume) and increasing in value (larger logs are often of higher, more valuable grades).

5. Thinning can upgrade the overall condition of the stand by selectively removing trees that are deformed, diseased, defective, infected with insects, and/or heavily suppressed.

6. A current thinning will make it possible to utilize or market trees that otherwise might be outcompeted and killed in the natural progression of the stand.

7. Thinning can shift stands to more favorable or desirable species compositions.

Several different methods of thinning are available, dependent on objectives. The preferential technique in this area whenever possible is a "low thinning" or "thinning from below," as it most closely imitates the natural process of stand succession in which the smaller suppressed trees were outcompeted by larger, healthier trees and/or killed by low-intensity fire. This generalized approach must be tailored to fit individualized stands, however, and may not be appropriate in which overstory conifers have died or are in poor condition.

Coniferous leave trees should be healthy, vigorous, and of good form; free from damage, disease, or insects; and free to grow after thinning. In addition, leave trees should have *at least* one-third of their total height occupied by a healthy crown (foliage). In this management area, leave trees should *usually* be the largest trees of any particular age class, as they are the most likely to exhibit the above traits and have superior growth rates. Having been dominant for the largest time, these larger trees will release more quickly than other less dominant trees, adding more volume in a shorter time. In stand improvement thinnings, larger trees should only be removed if they are obviously dying, heavily diseased, deformed, or insect-infested, or amidst an overstocking of other better, larger trees.

The pines, Ponderosa and (rarely) sugar, should generally be the preferred "leave" trees throughout the management area, with the possible exception of the more northerly aspects in the western parcel, where Douglas-fir would be equally preferred and currently dominates. The pines tend to outperform the other native conifers on harsher, more southerly aspects in the management area. Sugar pine is a particularly appropriate leave tree due to its scarcity in this area. It is particularly sensitive to overcompetition, however, and thus requires greater attention to reduction of stand densities in its vicinity. Prior to Euro-American settling of the area and the advent of fire exclusion, native stands contained a greater percentage of sugar pine and particularly Ponderosa pine, and current species compositions may often be outside the range of historic conditions. Ponderosa pine, however, is shade intolerant and only does well in full sunlight. More shade tolerant conifers such as Douglas-fir and incense cedar are preferred over Ponderosa pine for understory leave trees, as Ponderosa pine in shade is usually tall, spindly, and with poorly developed crowns. When thinning in the mixed coniferous forests in the management area, however, any of the existing species are appropriate leave trees, and overall tree vigor and condition is usually more important than individual tree species.

Hardwoods should generally receive the lowest priority in terms of leave trees, particularly if they are becoming overtopped by healthy conifers. They can offer significant growth and competition for preferred leave trees, subsequently causing reduced growth and vigor and increasing susceptibility to disease and insects. As previously mentioned, the increasing number of hardwoods in our native forests is largely a stand development response to the lack of fire and is probably outside the range of historic conditions in many stands. Hardwoods are now in a uniquely advantageous position to assert increasing levels of dominance, particularly in a world of infrequent, high intensity fire where their ability to stump sprout offers significant advantages over conifers.

If hardwoods are not significantly competing with preferred conifers, however, they can be left in existing stands and managed as well. Hardwoods will respond to thinning and density control just as conifers do; in fact, local research has suggested they respond even faster and more substantially to density control than do conifers. They may also be retained for their aesthetic appeal and/or left to prevent damage, shock, or sunburn to the upcoming saplings.

Hardwoods can also be excellent cash flow crops as they grow quite rapidly initially and subsequently can have a much shorter rotation age. In mixed stands, they may contribute to greater overall volume growth than in single species stands. Too, the future market for hardwoods is largely undetermined but has certainly been improving in recent years. Larger, straight-boled individuals free from rot may be particularly valuable and can be prioritized for retention in release treatments.

Hardwoods also perform numerous other ecological functions. They may perform the role of a "nurse crop," ameliorating site conditions so that natural regeneration of more shade tolerant conifers can occur. They are also important for maintaining diverse wildlife populations and add to the overall vegetational diversity on the property. Some hardwoods form important mycorrhizal associations with conifers and contribute to improved soil physical, chemical, and biological properties. Hardwoods intermixed in stands of conifers are also suspected to contribute to reduced wildfire intensity, particularly when compared to a uniform stand of young conifers. Thinning to promote hardwoods, although rare in the past, may be appropriate forest management in the years to come.

Spacing between leave trees should be such that the remaining canopies are mostly free to grow in all directions. Distance between coniferous leave trees can generally be determined by taking the average diameter of any small stand in question and adding a figure of 4 to 5 to determine the footage spacing between trees (this is known as the D+ rule). It may take several thinnings to achieve this idealized goal, however, as overdense stands can easily shock and/or bend over from excessive thinning.

Perhaps a better way to determine optimal densities, however, is to use basal area as a target rather than spacing. Spacing guidelines are more appropriate in plantations where species and diameters are much more uniform. Thinning by basal area allows one to easily make adjustments in the field for differing diameter sizes (and ultimate differences in competition). Basal area also allows one to leave trees in clusters (more typical in naturally developed stands) rather than forcing a given spacing upon the stand.

Preferred stand density after thinning also depends on the goals and desires of the landowner. If more rapid development of larger trees is desired, heavier thinnings are suggested. If slower growth for tighter rings, higher log quality, and/or other wildlife or aesthetic value is desired, lighter thinning may be preferred.

The ideals listed above generally apply to stands of a single species. Because of differing environmental and physiological needs of trees of different species, greater stocking levels can be left in multi-species stands than in stands of a single species. Too, a stand of diverse species is less susceptible to devastating insect or disease outbreaks.

As is hopefully obvious from the above discussion, decision-making regarding "leave" versus "take" trees is a complex one and varies with individual species, combinations of species, densities, sites, aspects, tree vigor, and a host of other considerations—not the least of which is the objectives of the owner. Given that these decisions will ultimately determine stand conditions many years into the future, the professionalism of the people actually implementing thinning decisions becomes very important in a long-term program of stand improvement.

In very intensive management styles, individual crop trees can be identified, retained, and allowed to grow to greater sizes and qualities such that their full value can be realized. This management style is often called individual tree selection and has been made particularly more viable in recent years due to the rapidly increasing value of logs. Maintaining aesthetic, wildlife, or other resource values important to many landowners can be more easily achieved in this style of management. It does, however, require a greater intimacy with the property on the part of the land mangers, and a subsequently increased investment in time, energy, and knowledge.

C. Reforestation

Two categories of reforestation—natural and artificial—are available to forestland owners. The forested stands in the management area are almost all currently fully stocked, if not overstocked, and will require little reforestation in the near future (unless a wildfire or heavy harvest removes a portion of these stands). However, understocked brushfields and pockets of insect-killed timber do currently exist within the management area and may need reforestation. Understanding both methods of reforestation is necessary in order to select optimal stand establishment strategies.

Natural Regeneration

Natural regeneration is a very effective form of reforestation, though often underestimated and underutilized. Most natural regeneration has historically been an unplanned event occurring naturally after fire and/or harvest activities disturb sites (such as was obviously the case in the first 15 years of this century in the management area).

However, if properly planned, it has several distinct advantages.

- It is free—or at most very inexpensive if limited site prep work is undertaken.
- Seedlings are site-specific and genetically adapted for survival and growth in a given site through thousands of years of natural selection.
- Seedlings can develop natural root systems that are more extensive than newly-planted nursery-bred seedlings, resulting in a more balanced seedling with a greater probability for growth.
- Far greater numbers of seedlings per acre can develop—an important consideration, particularly if damage from animals (such as gophers) is expected.
- Perhaps most importantly, it is simple and can achieve reforestation objectives without requiring the critical degrees of timing and professionalism required from start to finish in the process of artificial regeneration.

Given these significant advantages (particularly cost and ease of application), it is surprising that it is not intentionally used more often today. Several disadvantages, however, have prevented its wide acceptance:

- Its relative uncertainty of success in short time frames fails to assure rapid stand re-establishment following intentional or unintentional stand openings.
- Densities of seedlings established by natural regeneration are very unpredictable, particularly for large openings where seedling microsites have been significantly altered.
- It requires the preservation of residual, cone-producing trees that might otherwise be sold in timber sale activities.
- It is not nearly as effective if openings already have well-established competing

vegetation.

In appropriate situations, however, natural regeneration can be planned for and utilized to achieve reforestation objectives. The following considerations determine the effectiveness of any planned natural regeneration:

- Retention of numerous, cone-bearing overstory trees of preferred condition and species. Not only is seed production from these trees critical, but they also moderate temperature extremes that can cause a high percentage of mortality of young germinants, particularly from frost damage at high elevations and/or heat damage on hot, dry aspects.
- An appropriate seedbed with high amounts of exposed mineral soil (which can be developed through the use of prescribed fire in the management area).
- Reduced competition for moisture from well-established ground vegetation (grass, forbs, brush, etc.), and/or overstory trees; openings in stands have to be large enough such that excess light, water, nutrients, and space are available for establishment of new trees.
- Smaller stand openings or unit sizes that receive more seedfall per unit area than larger units.
- Adequate moisture, particularly in the first season when small germinants are most susceptible to mortality from lack of water.
- A minimal amount of livestock or big game activity that can trample and/or uproot the tiny one-year-old seedlings.

Natural regeneration of conifers has obviously been largely successful throughout most of the forested sites in the management area. Obviously, these stands can be managed from now on such that natural regeneration can be relied upon to maintain fully stocked stands. It has not been successful, however, in some instances—most notably where brush and/or hardwoods came in more rapidly and dominated the site following disturbance. If regaining these sites in the near future is a priority, then artificial regeneration may be required.

Artificial Regeneration

In response to increasing harvests (particularly clearcuts) and large scale wildfires, and the subsequent demand for adequate and immediate replanting of such areas, a fairly sophisticated and technical reforestation process has been developed in recent years. Success has been varied and depends on a long list of procedures which must all occur efficiently if the reforestation effort is to be successful. These procedures include, but are not necessarily limited to:

1. A good silvicultural prescription matching the correct species and stock type (elevation and seed zone) to the planting site;
2. Good nursery practices with production of good stock, preferably with large, fibrous rooting systems;
3. Adequate lifting, sorting, packing, and storing of seedlings while in the nursery;
4. Efficient and careful handling of the seedlings from nursery to the outplanting site with maintenance of seedlings in ideal storage conditions for temperature and humidity;
5. GOOD PLANTING TECHNIQUES!
6. Good site preparation prior to planting and vegetation control techniques after

planting to optimize a seedling's opportunity for survival;

7. Control of damage from various animals, particularly deer and gophers.

Usually, a breakdown in any one of these steps will insure seedlings' mortality. More often, it is the less than optimal operation of several of these steps that combine to sufficiently stress a seedling, with a subsequent increasing likelihood of mortality. It is a tribute to professional forestry that successes occur as often as they do today.

Of critical importance throughout southern Oregon—and certainly on any artificial regeneration effort that would occur in the management area—is the control of incoming competing vegetation that significantly stress a planted seedling. Site preparation (removal of existing vegetation by manual, machine, fire, or occasionally chemical methods) prior to planting provides the planted seedling with a good start at competing with other incoming vegetation. Control of competing vegetation after planting is perhaps even more important to seedling survival. Mulching, spot application of herbicides, or continued scalping and/or grubbing are the options for accomplishing this task, each with varying degrees of cost and success. The decision as to which method to use to accomplish moisture control must remain the responsibility of the owner, but regardless of technique the aggressive and effective accomplishment of this task is absolutely imperative to successful reforestation.

Planting success in the management area would be most effective if completed in February or early March. Seedlings should definitely be of a similar seed zone and elevation so that they match the site to be planted. Planning for the entire planting operation (reserving equipment, seedlings, etc.; lining up those to accomplish the work, etc.) should be completed in advance of the actual arrival date of the seedlings.

In essence, it is important to understand that planting nursery-bred seedlings that have undergone considerable stresses prior to actual insertion in the ground is a much different process biologically than seedlings that are initiated from seedfall. Not only do planted seedlings need much more care and optimal conditions, but are only planted 300 to 400 per acre per year as compared to repeated seeding of (often) thousands per acre in natural regeneration, but on a more unpredictable schedule.

Timber Harvest

In sound silvicultural planning, timber harvest can be utilized to help reduce stand densities so as to achieve certain (and often multiple) management objectives. If carefully and professionally accomplished, timber harvest can move existing stands closer to the range of historic conditions and hopefully offer greater potentials for long-term ecosystem stability and/or viability.

Other than fire exclusion, the largest impacts in forest stand development occur during that very short period of time when logging occurs. These impacts can be much more profound than the simple reduction in aesthetic appeal that is apparent to most lay people. These impacts can include: obvious changes in the age, size, and species composition of vegetation; damage to residual trees; potential loss of hard to replace older age classes that have become increasingly uncommon throughout the Western United States; destruction of a portion of understory vegetation; soil compaction if ground-based logging systems are utilized; a redistribution of fuel loading with possibilities of dramatic increases in logging slash and subsequent wildfire potentials; possible increases in ideal deleterious insect habitat (e.g., green slash) and/or disease substrates (e.g., fresh stumps); increased overland flow of water and subsequent potential for erosion, stream sedimentation, and watershed deterioration; changes in seral stages of vegetation with subsequent impacts on wildlife; rapid and radical changes in nutrient cycling and availability; and numerous other lesser impacts.

Mitigating the numerous impacts from this infrequent, but potentially highly impacting form of stand disturbance (logging) requires not only careful planning but very often professional help, particularly if a long-term, sustainable form of forest management is desired. It is recommended that the City of Ashland retain a professional forester(s) to oversee any proposed harvesting activities. That person(s) would oversee the following activities, all necessary if a successful timber sale is to occur:

(1) Planning the harvest operation including designation of appropriate harvest systems to achieve management objectives; location of property lines, corners, and timber sale boundaries; location of necessary roads, landings, and other important harvest related features; etc.

(2) Pre-mark timber for removal to insure that the desired trees are removed (a particularly important procedure to be accomplished professionally if stand improvement is desired).

(3) Cruise the timber to be removed so that all parties (City of Ashland, prospective logging contractors, and log purchasers) can plan appropriately.

(4) Pre-designate yarding and falling patterns to limit soil compaction and disturbance, stand damage, and potential logging costs.

(5) Pre-plan slash management and/or reforestation activities to be conducted by

either the logging contractor or a separate contractor.

(6) Designate timing of operations to reduce the possibility of damage from deleterious insects, as well as to limit damage to soil and watershed resources.

(7) Advertising the timber to be sold and contact potential log buyers to get the highest possible price and to secure a valid purchase order. This is an art in its own right, as each mill prefers logs of different species, sizes, grades, and lengths. Travel distance to an interested mill can affect the outcome of the bidding process, as well.

(8) Show the sale to several well-qualified logging contractors and obtain a favorable price for accomplishing the job. Logging price can be considerably variable depending on the type of logging and associated activities required, as well as the capabilities of obtaining a market price from prospective logging contractors.

(9) Prepare an appropriate logging contract to be reviewed by the City of Ashland.

(10) Acquire all necessary permits and insure that all appropriate laws and regulations are being adhered to.

(11) Administer and supervise the actual sale implementation to insure that the job is being accomplished as agreed, with minimal damage to residual stands, advanced reproduction, soils, streams, aesthetic values, recreation sites, or other important resource values.

(12) Oversee the accounting for all logs removed, subsequent development of scale tickets and summaries, and proper distribution of monies to all participating

parties.

Perhaps most importantly, the professional forester(s) must conduct the timber sale in such a fashion as to prioritize silvicultural objectives desired by the owners.

Given that so much of the economic and ecologic value of a small woodland operation is determined and/or impacted during harvest activities, it is vitally important that the City of Ashland carefully plan prior to initiation of the project. Combining volumes from several properties to create a larger timber sale is an excellent way to improve the economies of scale whereby improved prices from log purchaser and/or decreased costs for logging can be obtained.

Although a well-planned and conducted logging can quickly revegetate with minimal long-term impacts, inappropriate planning, construction, and/or maintenance of roads and skid roads can continue to impact watersheds for decades after their initial installation. Sediment entry into stream systems as a result of road surface erosion is usually much larger than that from timber harvesting. Perhaps more importantly, roads intercept natural groundwater flow and subsequently channel water, allowing for much more rapid accumulation of high volumes of water during peak storm events. It is in these situations that major erosion and watershed deterioration can occur.

Less than optimal road construction techniques not only cause significant watershed degradation, but can be quite expensive as well, as continued maintenance and/or road rebuilding following failure can be even more costly over time than the original construction costs.

Watershed values are of the highest priority for the City of Ashland owned lands in the Ashland Watershed. The value of high quality water will obviously continue to rise rapidly throughout the Western United States, where water is usually at a shortage. Forest management activities must be modified and/or tailored to prevent additional impacts to the water resources of the Ashland Creek watershed. For this reason, it is recommended that no additional roads be constructed in the implementation of forest management activities. The very sensitive and erosive nature of the decomposed granitic soils in this area further substantiate this course of action. Further, the existing granite pits and roads in the watershed need considerable restoration and/or upgrading. It is recommended that the City of Ashland retain the services of a consulting Engineering Geologist to address these important issues.

Due to the above critical concerns, harvest systems should be limited to the use of helicopters only throughout almost all of the City-owned lands. Ground-based logging systems would be inappropriate, except perhaps in the area immediately adjacent the gravel pits and/or narrow strips immediately adjacent main access roads.

Helicopter logging, however, is expensive, with costs very sensitive to certain attributes of timber sales. These often interrelated attributes include:

1. size of the logs to be removed;
2. average number of board feet per turn of logs;
3. the clustered or scattered nature of the logs to be removed and subsequent volume per acre;
4. locations of available landings and roads, and subsequent average flight times;
5. the total volume of the sale.

Unfortunately, achieving silvicultural objectives can be very expensive when helicopters are the intended harvest system. In this management area, the small size of the logs suggested for removal, the scattered nature of those logs, the low volumes per acre, and the low total volume all combine to suggest quite high helicopter logging costs, perhaps to the point of superseding log value. Perhaps the most important of these is total log volume, as the costs of merely moving a helicopter to a job can effectively negate its economic viability if the total volumes are small. For this reason, the potential viability for such a sale could be dramatically increased if additional volume outside the management area was included. It is unfortunate that considerable volume was removed from this management area in 1990 by helicopter without an appropriate level of silvicultural planning to achieve other objectives. The possibility of now re-entering this area in an economically viable stand improvement harvest have been much reduced.

Although collecting formal cruise data was not part of this report, rough estimations suggest that 150,000 to 250,000 board feet could be removed in a sanitation salvage/ commercial thin type of stand improvement harvest in the management area. Approximately one-quarter to one-half of that volume consists of trees that have already died but yet are still merchantable. However, these dead trees will rapidly decline, with perhaps as much as fifty percent of existing standing dead volume per year decaying to a non-merchantable status. Further, it is highly likely that additional trees will die each year unless planned silvicultural activities upgrade stand health and vigor and hopefully reduce spreading bark beetle infestation.

The negative impacts associated with no activity are described elsewhere in this report, the most significant being an increasing wildfire hazard that is already extremely high.

It is suspected that the inability to conduct a timber sale to remove these dead and dying conifers (for whatever reason) would most likely then suggest paying for felling of many of these snags for wildfire prevention reasons. This would not only be expensive, but would add additional and highly combustible ground fuels, mostly in highly undesirable locations (adjacent the main haul road up the canyon where considerable mortality has already occurred). An expensive piling and burning of this material, much as occurred in Lithia Park, would probably also be necessary.

Strictly from a stand management viewpoint, a reduction in stand density will be necessary in order to improve stand vigor and hopefully mitigate ongoing spread of bark beetle induced mortality in the management area. Theoretically, this reduction can come from any of the species and size classes within the stand. The City of Ashland could choose to forego any harvest-related income and strictly reduce stand densities to appropriate levels through pre-commercial thinning and release operation such as previously described. Many existing and developing snags would then also have to be felled to meet wildfire prevention objectives—an additional cost. On the contrary, it is not possible to "log our way to forest health" in this situation; timber sales alone will not be sufficient to reduce stand densities to appropriate levels to encourage forest health. Utilizing timber sales alone would be largely a reactive approach (responding to ongoing insect or fire killed timber), rather than a proactive one. In fact, a simplistic approach of ongoing mortality salvage would prevent ultimate development of the most fire resistant stand type—one dominated by larger overstory conifers that occupy site resources and subsequently discourage development of dense understory ladder fuels.

It is suggested that treatment of both overstory (merchantable timber) and understory vegetation will be necessary to achieve the objectives outlined by the City of Ashland. Ideally, removal of overstory timber would be accomplished first, because trees damaged in that operation could be removed in the ensuing treatment of understory vegetation. However, given that treatment of non-commercial vegetation is essential to accomplishment of the City's objectives for this management parcel, it is also possible that this work could be done prior to timber harvest. Several disadvantages exist, however: (1) Some damage to already-treated stands would occur during subsequent felling and yarding operations. (2) Selection of leave trees during thinning/release operations could be complicated by not knowing which merchantable trees would remain on-site after harvest. Logistically and perhaps politically, however, it may be easier to conduct non-commercial silvicultural activities such as thinning and release treatments, slash treatment, prescribed underburning, fuelbreak construction, etc., than to initially attempt a helicopter timber sale. The economic viability of a timber sale is, as yet, undetermined and depends on a more accurate appraisal of projected timber volumes, projected logging costs, and availability of helicopter logging contractors.

Fire Management

From almost any resource, social, or economic viewpoint, a watershed-level stand replacement type of catastrophic wildfire is an extreme negative. Reducing the risk of that type of fire in the Ashland Watershed is an obvious high priority.

In the absence of natural fire and/or an active thinning and fuel reduction program, the chances for damage from wildfire have been steadily increasing to the point where the problem can now be considered extreme in most of the forests of Western North America, and the Ashland Watershed is certainly no exception. In a careful and professional assessment in the 1995 Bear Watershed Analysis (Ashland Ranger District, 1995), the designated management area straddles the area delineated as the highest possible category for fire hazard and risk. Fire risk is particularly high in this area due to high likelihood of ignition in the area. Since 1967, 53 fires have occurred in the interface area outside of the city limits of Ashland, and 93 percent of these fires have been started by people (Ashland Forest Plan, 1992). Personal communication with Bill Rose, Ashland Ranger District fire and management officer, indicated that the management area is a particularly important location from a landscape level wildfire management perspective because:

1. It is adjacent the area of highest fire risk and most likely source of ignition—the urban Ashland area and associated interface.
2. The narrow canyon topography of this location produces a "Venturi effect" when daytime upvalley winds are constricted, subsequently creating severe, rapidly escalating fire behavior in a wildfire event.

Since fire intensity and rate-of-spread can escalate so rapidly, increasing the likelihood of successful wildfire suppression early in its initiation (i.e., in the lower watershed area) is critical to preventing wholesale catastrophic stand replacement wildfire. Preventing this type of wildfire is particularly important because of several very valuable "values-at-risk" in the area:

- a largely unroaded and undisturbed forest ecosystem including considerable late successional reserve and a research natural area.

- a watershed that provides the primary source of water for the City of Ashland.
- considerable urban and interface real estate values.

Fire requires three basic elements to occur--fuel, oxygen, and an ignition source. Obviously, eliminating oxygen is not a viable alternative. Historically, the major thrust of fire prevention efforts (i.e., Smokey the Bear) has been to prevent ignition. Unfortunately, ignition can never be totally prevented. Lightning, arson, carelessness, and accidents always insure that fire will occur in forested settings. With fuel loadings increasing each year, the chance for a "cool, low-intensity burn" in mid-summer, such as were the rule prior to the Euro-American settling of the area, have long since passed. When burning at maximum rates in southern Oregon, wildfire has consumed as much as 80 acres per minute.

It has increasingly become apparent that management of fuels, both green and dead, provides the only long-term opportunity for returning the likelihood and subsequent intensity of wildfire to safer prehistoric levels. This is a premise which guides much of the silvicultural prescriptions and ultimate stand management suggested in this report.

Productive fuels management involves working with three primary conditions of fuels: types and amounts, arrangement, and continuity.

Greater accumulations of fuels obviously increase both the likelihood and ultimate intensity of wildfire. Smaller diameter, fine flashy fuels are easy to ignite and encourage rapid rate of spread of wildfire, while the opposite is true for larger fuels (although larger fuels can greatly contribute to the ultimate intensity of wildfire).

Arrangement of fuels is important because dense, compacted fuels close to the ground do not pose near the wildfire hazard as do "ladder" fuels that form a constant fuel source from ground into forest canopies. Snags are also a serious fuel arrangement problem because, once ignited, sparks and fire can be spread great distances from their tops.

Fuel continuity is important because fire spreads rapidly in continuous ground and aerial fuels. Interrupting the horizontal continuity of fuels (fuelbreaks, roads, grasslands, etc.) basically removes fuel from the fire, thereby preventing or at least slowing its spread. Pruning of trees may help to further decrease the vertical continuity of fuels.

Once initiated, fire behavior is determined by weather, topography, and fuels. Even though we cannot avoid the hotter, drier weather of summer, we can obviously develop much greater care and concern during fire season. Likewise there is little one can do about topography, but knowing that fire spreads much more rapidly uphill and in higher wind conditions one can analyze existing topography and subsequently prioritize wildfire prevention and fuel reduction activities. The upper one-third of slopes are target areas for fuels modification because (1) they are usually the area of major suppression efforts during wildfire events, and (2) the effects of convection and preheating upon fire behavior effectively end at ridgetop locations.

Reducing the likelihood of severe destruction from wildfire depends, then, on an aggressive proactive fuels modification and treatment program in the management area, as well as in the Ashland Watershed as a whole. Three primary types of fuel reduction should be considered and implemented: fuelbreaks and shaded fuelbreaks, defensible fuel profile zones, and area-wide fuel reduction.

Fuelbreaks are strips of land on which native vegetation has been modified and reduced such that fires burning into them are more easily controlled. Shaded fuelbreaks retain a minimum number of healthy overstory trees with flammable understory vegetation largely removed. Numerous fuelbreaks and shaded fuelbreaks have been installed in the area by the U.S. Forest Service, Ashland Parks and Recreation, and several private landowners. Although they can be constructed around homes, roads, or other improvements, they have been typically constructed in strategic locations, particularly ridgetops, in the area. They historically have been 150 to 250 feet wide, designed to effectively suppress encroaching small to medium-sized wildfires. Not only are fuels reduced in these locations, but fire fighting personnel have easy access and aerial retardant can effectively reach the ground.

However, in severe fires, particularly those with excessive spotting, fuelbreaks have often been ineffective. In these situations, larger zones of modified and reduced fuels have greater effectiveness and use. These "defensible fuel reduction zones," which often use existing fuelbreaks as anchor lines, are much wider than fuelbreaks, perhaps as much as one-quarter mile wide. These would include treated stands with reduced amounts, continuities, and/or distributions of fuels that would provide additional zones of opportunity for controlling wildfire.

Finally, area-wide or landscape-level fuel reduction greatly decreases both the likelihood and intensity of developing wildfire, but usually occurs during the final phases of a fuel modification program after the more highly-prioritized and cost-effective areas are treated. In all three situations, effective planning can be conducted to coordinate fuels reduction with simultaneous accomplishment of other silvicultural values. This is particularly true in the larger scale fuels modifications activities, such as defensible fuel reduction zones or area-wide fuel reduction.

In all of these approaches, removal and utilization of any marketable material (such as logs, post and poles, firewood, etc.) is an excellent method of achieving fuels reduction while garnering some income to offset expenses. Unfortunately, the costs of fuel (and commodity) extraction may supersede the potential income, particularly when access is poor or non-existent (except by helicopter), as is the case throughout almost all of the management area.

In high priority areas, fuel reduction will most likely have to be done by burning—either pile and burning and/or prescribed underburning. Pile and burning is the most common form of fuel reduction using fire. Slash is piled and often covered with plastic to facilitate burning in winter when little risk of fire escape exists. Swamper burning is similar to pile burning except that slash is thrown into actively burning piles. Neither of these techniques truly emulates the low intensity surface fires of the pre-settler era, but rather are small spots of intense fire. Prescribed underburning, however, can emulate the low intensity surface fires of the past. Surface fuels are burned in place, rather than piled and burned. Prescribed burning is a much more exacting endeavor and demands a far greater professionalism, as the windows of opportunity are narrow. The opportunity to burn must fall within an exact prescription in which fuels, weather, and logistics are all appropriately aligned to achieve pre-determined objectives. This endeavor obviously requires much greater levels of pre-planning, and associated greater levels of risk.

In low priority fuel management areas, lopping and scattering slash so that it lays closer to ground level will speed up decomposition and more quickly reduce the drastic fire danger. It must be noted that lop and scattering following thinning, although not as desirable as other treatment techniques that remove it from the site, is certainly preferred to not thinning at all even from a wildfire prevention point of view. Wildfire danger is extreme in dense, stagnant thickets of coniferous saplings, and even though downed slash from thinning and release activities will represent an additional hazard for several years, the stand improvement that results will encourage a rapid decrease in the vertical continuity of fuels as trees grow and canopies become further removed from ground level. Too, improved vigor of leave trees prevents the establishment of numerous snags—a potentially severe wildfire control problem. Slash should lose its fine fuel component (twigs and needles) within several years and in slowly compressing to ground level, wildfire potential in the fuelbed will be decreased.

Any plans for considering the use of fire in forest or resource management on private woodlands must be coordinated with the Oregon Department of Forestry. Not only does this coordination help prevent potential wildfire ignition, but also limits smoke production and direction to days when it will least impact populated areas.

A comprehensive watershed level fire management strategy will provide the most effective possibility for wildfire prevention and suppression. Coordination with the U.S. Forest Service is imperative in this endeavor.

Planning for Biodiversity, Wildlife Habitat, and Long-term Site Productivity

Biodiversity is a commonly used term today describing a subjective measurement of the different types of living organisms that reside in any given area. Two measures of diversity are species diversity (the different species in a given area) and ecosystem diversity (the different types of habitat that support various living organisms). Both species and ecosystem diversity can be measured fairly accurately on the ground. Generally, however, effective management for total biodiversity most commonly attempts to maximize ecosystem diversity, as maintenance of a wide variety of habitat and vegetation types insures the greatest possibility for maintenance of the largest number of viable populations of species.

Maximizing ecosystem diversity, however, requires long-range planning over larger, watershed-level areas such that specific habitat types can be planned for over time and space. This type of coordinated planning has rarely been done for a variety of reasons. However, our failure to do so has resulted in significant gaps in habitat types. The decline in numbers of animals (such as Spotted Owls) are an outgrowth of such failures. The City of Ashland is encouraged to participate with the Ashland Ranger District of the U.S. Forest Service in developing a coordinated plan for maximizing ecosystem diversity and wildlife habitat values for the entire Ashland Watershed.

On a landscape level, a multiplicity of habitat values is highly desirable. For example, in the designated management area, very little mature timber or late successional vegetation types exist, making this area largely unsuitable northern spotted owl habitat. However, as concluded in the 1995 Bear Watershed Analysis, maintaining favorable spotted owl habitat is not possible on all acres all of the time and is particularly unlikely in the lower Ashland Watershed where the designated management area occurs. Further, fuel reduction activities that may eliminate multi-layered understories and subsequent sub-optimum spotted owl habitat may yet be preferred in strategic locations to prevent catastrophic wildfire and subsequent destruction of much greater amounts of late-successional species habitat (Ashland Ranger District, 1995). Conversely, the younger vegetation and stand structures that currently dominate the designated management area are much less common in the late successional reserves higher in the watershed, and subsequently support wildlife species that prefer these habitat conditions. Within the management area, however, improving biodiversity and wildlife habitat values can be achieved by increasing structural diversity of forestlands through such practices as uneven-aged management; retaining snags and logs, particularly of larger sizes; or leaving patches of unthinned or untreated areas during harvest or thinning operations. These practices must be carefully coordinated with appropriate fuel and wildfire management objectives, however. Structural diversity goals may be secondary to wildfire prevention goals, given that large-scale disturbances such as large wildfires dramatically reduce, if not eliminate, structural diversity. These biodiversity objectives can be best achieved in areas not highly prioritized for fuels management, such as in riparian areas and in the lower half of the topography.

Snag retention is a particularly important biodiversity and wildlife habitat objective. Over forty different species of birds and six species of mammals in southern Oregon rely on snags, at least partially, to complete their lifecycles. Any larger snags (20 inch DBH and larger) are particularly important as they offer increasingly rare nesting locations for some of the mammals and larger birds that depend on them—and are a critical habitat feature that has rapidly declined during the years of harvesting old growth. The Ashland Forest Plan (McCormick and Associates, 1992) calls for retention of 4 to 7 snags and downed logs per acre but also cautions that they should be placed "outside of natural wildfire control lines."

Perhaps the most critical habitat for wildlife species and biodiversity objectives is riparian habitat, a key feature of the Ashland Watershed. Although no riparian habitat occurs within the designated management area, the City of Ashland is encouraged to again coordinate with the Ashland Ranger District in the development of a coordinated management of riparian habitat in the Ashland Watershed. The 1995 Bear Watershed Analysis (Ashland

Ranger District, 1995) contains an excellent description of riparian and aquatic management guidelines.

Specific activities can also be undertaken to maintain long-term site productivity. The loss and/or displacement of nutrients within a forest ecosystem has become of increasing concern. Unfortunately, fire suppression and exclusion has dramatically shifted the percentage of total site nutrient capital above-ground (as opposed to below-ground). This condition has likewise increased both the likelihood and intensity of fire. As a result, these higher-intensity wildfires of today are consuming a much greater percentage of total site nutrient capital than the more frequent but less-intense fires of the pre-settler era—a significant impact on long-term site productivity. Harvesting can do the same thing by removing large percentages of above-ground biomass through whole-tree yarding, chipping and/or removal; and/or intense burning of all slash after major harvests. Smaller harvest entries and/or partial cuts with considerable green tree retention can usually maintain satisfactory amounts of nutrient capital. Over 50 percent of the nutrient capital in the above-ground portion of the tree is in the needles, fine twigs, and small branches, and if these alone are left on site then impacts to long-term site productivity can be minimized during harvesting. Of course, once again, these ideals must be balanced with critical fuel management objectives.

It is also important to leave several large logs per acre on-site after harvest to decay in place. Recent research has shown these to be important reservoirs of moisture, nutrients, microbial activity, and small animal activity—all performing critical roles in maintaining long-term site productivity. Large logs that have limited market value ("culls") are good logs to be retained on site during a harvest operation.

CHANGES IN RESOURCE VALUES RESULTING FROM CHOOSING A "NO ACTION" ALTERNATIVE

Disturbances of forests are important and ongoing events in the natural processes of forest ecosystem development. In fact, it was our aggressive *prevention* of disturbance that has contributed so significantly to the silvicultural predicaments that this report is attempting to identify and address. Bark beetle infestation and subsequent tree mortality is a normal occurrence in healthy forest ecosystems. The rapidity and the scale of its occurrence in the management area and elsewhere in the immediate vicinity, however, is of great concern—particularly given that it is occurring in a very important watershed adjacent very high real estate values.

The change in stand conditions being rapidly created by bark beetle induced mortality causes many direct and indirect changes affecting other resources as well, and must be considered when determining management direction and subsequent activities. The management choice to "do nothing" is, in effect, accepting the vegetational changes (such as overstory conifer mortality) that will continue to occur, and perhaps even more rapidly.

Extensive conifer mortality obviously results in return of the vegetative community to the earlier stages of succession. Species more well adapted to thrive in these new conditions tend to dominate—particularly brush, grass, and broadleaved herb species. Trees left undamaged, most notably hardwoods such as Pacific Madrone and the oaks, respond to more favorable conditions and become even more dominant, in some cases even further restricting the future development of conifers. Simultaneously, this vegetation type may also encourage the wildlife species that depend on the earlier stages of succession.

Ongoing and extensive conifer mortality dramatically increases the potential for damage from wildfire. Standing snags are a serious wildfire suppression problem, as they can ignite and spew sparks from their tops, greatly increasing spotting and the subsequent rate of spread of wildfire. Falling, burning snags can also represent serious safety hazards and potential hazards to adjacent houses and/or real estate (even if the fire is otherwise maintained at ground level). The developing dense understory vegetation following demise of overstory conifers can be an even greater wildfire hazard than dense overstory timber, as a large distance between ground level and foliage in the crowns—a break in the vertical continuity of the fuels—reduces fire hazard. Overstory snags that fall into this developing dense ground vegetation further exacerbate the developing fuel problem and wildfire hazard. It is suspected that this vegetation type (young, developing conifers, brush, and hardwoods with numerous snags, both standing and down) was the fuel type that burned so intensely on northerly aspects in 1910.

Rapid mortality of coniferous stands can also decrease slope stabilities, as roots die and begin to lose their ability to hold soils in place. Although roots of incoming vegetation slowly replace those of the previous conifers, there is a gap of time when soil stability is significantly reduced. Often the incoming vegetation is not initially as deep-rooted as the larger overstory conifers. It is for this reason that establishing of dense, shallow-rooted grass species that prevent establishment of deeper-rooted native brush, hardwoods, or conifers is not recommended as a long-term slope stability procedure.

Openings created by small patches of mortality in a dense stand of conifers can be a positive development for wildlife habitat, however. The resulting stand has greater variability in stand structure and vegetational diversity, both features that attract greater numbers of species of wildlife per unit area. In essence, a greater amount of edge effect results. However, with ongoing mortality (particularly of the kind that occurred in Lithia Park and is currently beginning in portions of the management area) in which conifers are totally removed from the stand, both stand structure and vegetational diversity ultimately are reduced.

Snags are also important wildlife habitat features, but are not appropriate in areas such as fuelbreaks which are designed to maximize wildfire suppression capabilities. The Ashland Forest Plan (McCormick and Associates, 1992, p. 47) specifically recommends "4 to 7 snags or large downed logs per acre outside of wildfire control lines." Development of an ongoing snag management policy should certainly be a long-term management objective for City of Ashland owned forestlands and should be conducted on a watershed level through coordination with the U.S. Forest Service, who owns most of the land in the watershed.

No spotted owls currently nest in the management area. The area is also not good spotted owl habitat due to the younger ages and sizes of the coniferous timber in the stands AND the lack of vertical structure and multiple canopy classes within the stands. The ongoing mortality of older overstory conifers in the management area only further discourages the development of stand conditions that can act as future spotted owl habitat. The increasing fire hazard and threat of large-scale stand destruction, returning vegetation back to the earlier stages of succession, is a particularly undesirable "step backward" in development of appropriate spotted owl habitat. Management activities designed to prevent a catastrophic wildfire (such as described in this report) will hopefully allow for continuing development of stand structures favorable to spotted owls. Stand density reductions, both commercial and pre-commercial, that are designed to increase leave tree vigor, reduce bark beetle induced mortality, and reduce the likelihood of stand replacement wildfire will hopefully continue to allow the future development of spotted owl habitat values, while discouraging the destruction of existing spotted owl habitat in the Ashland Watershed through decreasing the risk of catastrophic wildfire. The Ashland Forest Plan (p. 46) specifically identifies this as a primary goal: "Retain existing old growth as long as possible and manage younger trees in a manner that they will become the replacement old growth as rapidly as feasible (McCormick and Associates, 1992).

Aesthetic values vary by individual, but stands of contiguous bark beetle induced conifer mortality are seldom considered aesthetically desirable. This has important implications for long-term recreational possibilities in the management area. Several trails utilized by mountain bikers and hikers already criss-cross the management area and the presence of standing snags in these areas can obviously represent a potential liability.

Ongoing mortality and the resulting changes in stand conditions and resource values will continue to negatively impact the primary objectives delineated for this area by the City of Ashland: (1) protection of watershed values and maintenance of quality and quantity of water for the City; (2) maintenance and/or promotion of forest and ecosystem health; and (3) reduction in wildfire hazard and risk.

MANAGEMENT UNIT DESCRIPTIONS/PRESCRIPTIONS

The 105 acre management area has been subdivided into management units and subunits based on given environmental site conditions, the suspected disturbance regime prior to the time of Euro-American settlings, and the more recent management history. This delineation of the property into management units and subunits will hopefully facilitate understanding and implementation of desired management activities.

Several terms are particularly important if one is to understand the descriptions and prescriptions as described in the following section. These terms—site index, rings per inch, and basal area—generally refer to ways of understanding forested stands, and will now be described in more detail.

Site index is a method of measuring and describing the potential productivity of any given site, particularly for the growth of conifers. Even sites that have no conifers (but could have) have a site index, based on site productivity potentials for the existing soil type and depth. Site index is usually determined by measuring heights and ages of dominant trees of a given species in a stand. As a generalization, dominant conifers tend to grow to predictable heights over time based on physical site characteristics and regardless of stocking levels. On better sites, trees will grow taller in the same length of time. Obviously, understory, diseased, defective, and/or suppressed trees or trees in severely overdense stands cannot grow at these rates and should not be included in site index measurements. Site index tables have been constructed for all coniferous species, usually based on projected heights at 50 or 100 years. The standard used in this report is 100 years and the number generated is the expected height of dominant trees of a given conifer species on that site at age 100.

Rings per inch refers to a way of measuring and describing a rate of growth of a particular tree or, collectively, a group of trees. Since conifers typically add on one "ring" each year, the term rings per inch refers to the number of years needed for a tree to grow on inch radially. The healthier and more vigorous a tree, the fewer the current number of rings per inch. This figure can be used to assess changes in an individual tree's growth ("release" following thinning or harvest; decline as stands become overcrowded, etc.) or to compare trees or stands and subsequently make suggestions for management. Rings per inch is determined with an increment borer that drills and removes a small core from the tree.

Basal area is a very useful term used to determine the general density of trees within any given stand. Its unit of measurement, square feet per acre, refers to the cross-sectional area of all the stems in an acre of forest as measured at DBH. This is important because that cross sectional area can be closely correlated with the amount of competition felt between trees (or any vegetation for that matter) on a given site (i.e., 160 square feet per acre is more "dense" than 120 square feet per acre for a given site). Obviously, better sites can support greater basal areas without excessive competition between trees. It is particularly useful in thinning or harvesting projections because it can provide an idealized number to shoot for regardless of variations in tree spacing or diameters. It is seldom that stands of conifers are all of equal diameter or pre-treatment spacing. Obviously, ideal spacing should be different after treatment for trees of different diameters. Since many diameters are typically left after thinning or harvesting in native southern Oregon stands, basal area is a much more useful guideline than spacing.

Unit A - 8 acres

Description - Unit A is located on 35 to 55 percent easterly aspects on either side of Ashland Loop Road in the northeastern corner of the management area. Unit A is comprised of two subunits: A_1, which was treated in the summer of 1995, and A_2, whose management history if similar to that throughout the remainder of the management area. Prior to treatment, subunit A_1 was similar to many other places in the management area in that the stand was significantly overdense and bark beetles had already caused considerable mortality of Douglas-fir. Fire risk and hazard were both extreme as well. The area was of particular concern due to its location immediately adjacent valuable homes and property to the north and east. A stand density reduction treatment was conducted in two phases: (1) a harvest of one log truck load of dead merchantable Douglas-fir located in the upper half of the unit and easily winched to roadside, (2) an understory thinning/release treatment to create more optimal stand densities. The resulting slash was piled and burned by an Americorps crew hired by the City of Ashland. Stand densities went from pre-treatment averages of 750 to 1,000 trees per acre and 175 to 200 square feet per acre to post-treatment averages of 300 to 400 trees per acre and 100 to 125 square feet per acre. Variation was considerable within the post-treatment unit, however, as part of the area was considerably understocked due to complete mortality of Douglas-fir, while other areas remained untouched, either by bark beetles or by treatment activities (i.e., the area within 50 feet of the topographical draw). Currently, about 50 percent of the trees and stand basal area are Douglas-fir, 25 percent pacific madrone, and the remainder primarily Ponderosa pine or California black oak. A more in-depth prescription of this pre-treatment unit and explanations for silvicultural prescriptions ("Silvicultural Prescriptions for Two City of Ashland Owned Parcels") was submitted by this company to the City of Ashland in Spring, 1995. Subunit A_2 is typical of the pre-treatment stand conditions in subunit A_1. The stand is currently in a rapid state of decline, with bark beetle induced mortality occurring from the edges of the stand inward; in this case, proceeding southward and upward in elevation. Mortality of almost all of the Douglas-fir in a one-quarter acre patch has occurred at the north end of Subunit A_2. Further to the south and particularly closer to ridgetop, 1/10 to ½ acre patches of Douglas-fir (presumably dead or dying) were removed in the 1990 helicopter sale. Unfortunately, the residual trees left in both of these areas were the small (less than 2 inches DBH), suppressed trees that have yet to respond (and most likely will not respond) to the sudden increased availability of water, light, nutrients, and space. Grass, forbs, creeping snowberry, poison oak, and other ground covers have become dense in these areas, however. The remainder of the unlogged portions of the unit are currently dominated by considerably overdense stands averaging 200 to 225 square feet per acre, primarily of small, 6 to 12 inch DBH Douglas-fir poles and similar sized Pacific madrone. Stand densities decrease and mortality increases closer to the ridge to where site productivity decreases and Ponderosa pine and California black oak form greater percentages of the stand composition. Ponderosa pine are the healthiest, most vigorous conifers throughout most of the subunit A_2, and are particularly thriving where they have been released by mortality and/or logging of adjacent Douglas-fir (growth has at least doubled in these individual pines). Estimated 100 year site index is 95 to 105 for both Ponderosa pine and Douglas-fir.

Prescription - Subunit A_1 has already been treated with a thinning/release entry that should be a model for similar work elsewhere on the property. The stand was purposely left slightly overdense in this situation largely for aesthetic reasons. Stands treated elsewhere on the property, including subunit A_2, can be thinned slightly more heavily, particularly if the stands are more vigorous than those in subunit A_1 and in-stand mortality is less pronounced. Almost all of the remainder of the property will need to be done (if desired) by helicopter, as opposed to the single load of logs removed by ground based logging systems in this situation. The slash piles created following the thinning/release treatment in subunit A_1 should be burned in the spring of 1996. At that time, removal of the few trees that have died (or are dying) in the interim should be accomplished and incorporated into the slash piles. The ridge at the top of Unit A and adjacent subunit B_1 is an ideal location to create a 200+ foot wide shaded fuelbreak for the full length of the ridge on City of Ashland ownership (approximately 1,500 feet). This 7 acre shaded fuelbreak should be a high management priority and would offer an excellent place to stop advancing wildfire from either direction, and subsequently prevent considerable loss of important values (urban real estate in one direction; Ashland Watershed in other direction). This shaded fuelbreak would also tie-in with an existing shaded fuelbreak and defensible fuel reduction zone on private land at the southern end of the unit. This private parcel, treated by thinning and release from below followed by diligent slash utilization/treatment, is an excellent example of very positive outcomes that can be expected from proactive stand level treatments designed to achieve both silvicultural and wildfire prevention objectives. The remainder of Unit A and subunit B_1 should also be prioritized for a defensible fuel reduction zone. In the remainder of Unit A, stand density reduction similar to what occurred in subunit A_1 will be necessary to restore health and vigor to the area. This should primarily be pre-commercial release treatments to remove understory competing vegetation and release preferred leave trees. Although most of this work is precommercial, dead, dying, defective, deformed, diseased, or heavily suppressed merchantable timber could be harvested by helicopter if a property-wide sale can be developed. The close proximity of Ashland Loop Road may allow utilization of some of the resulting slash if a qualified and properly insured contractor can be found. The remaining slash should be piled and burned. Slash created during the 1990 helicopter logging was untreated and left in these openings, and should be piled and burned with developing thinning and/or logging slash. In conjunction with pile burning in subunit A_1 and creation of a shaded fuelbreak along the ridge, an excellent 300 to 600 foot, defensible fuel reduction zone with good access (Ashland Loop Road) through the middle of it would be created. Implementing these fuel reduction treatments would change the character of the unofficial "Alice in Wonderland" hiking and mountain biking trail, however, that runs along the ridgeline. Portions of this trail have also been deeply eroded and creation of drainage devices (water bars, rolling dips) is suggested. Small openings created during helicopter logging and/or bark beetle attack will naturally regenerate over time and in the interim provide stand level structural diversity. The hazard for slumping/landslides is less in this unit than in Unit D, where immediate reforestation is suggested in a similar situation to help encourage slope stability.

Unit B - 42 acres

Description - Unit B is comprised of 6 separate subunits located on 45 to 75 percent northerly to northwesterly aspects. These subunits are all comprised of even-aged, considerably overdense stands of primarily Douglas-fir pre-commercial and small commercial pole timber 6 to 12 inches DBH. These stands were initiated after the 1910 wildfire and undoubtedly grew up in dense "doghair" thickets. The intense competition undoubtedly allowed little differentiation between individuals and the stands ultimately stagnated, with few healthy or vigorous individuals. This is evidenced by their very small and thin crowns (few are over 30 percent crown ratios) and very poor growth rates. In fact, even the occasional dominant 12 to 16 inch DBH conifers are growing at 15 to 20 rings per inch, with smaller trees growing at 25 to 50 rings per inch. In this dense competition for site resources, virtually all trees less than 4 inches DBH have died, and those less than 8 inches DBH are either dying and/or extremely suppressed. An average of 800 to 1,000 trees per acre currently exist throughout Unit B, and basal areas average about 200 square feet per acre, with small patches as high as 250 square feet per acre. These are extremely high numbers for these types of stands and are indicative of severe overcrowding. Douglas-fir comprises about three-quarters of that total basal area, Pacific madrone about 15 percent, and the remainder in California black oak or the rare Ponderosa pine, sugar pine, or incense cedar. Site productivity, tree diameter, and tree vigor all decrease in upslope directions, with considerable mortality evident on and near the ridgetop locations that are transitional with the less productive sites on adjacent, more southerly aspects. Understory vegetation is sparse in these stands where overstory trees utilize almost all of the site resources. However, creeping snowberry, tall Oregon grape, grass, honeysuckle, and poison oak become much more common in small openings, most notably in the powerline easement where they combine with stump-sprouting Pacific madrone and California black oak, Douglas-fir and incense cedar seedlings and saplings up to 10 feet tall, and other more light-dependent shrubs such as deerbrush ceanothus and oceanspray. Estimated 100 year site index in Unit B is 105 to 115 for Douglas-fir.

Prescription - Unit B has an existing stand condition that is a silvicultural nightmare. In the absence of understory fire, manual thinning and release, or other methods of reducing stand densities, the stands in Unit B have stagnated. Virtually the entire stand of Douglas-fir is currently of poor vigor and very susceptible to attack and demise from the cadre of insects that kill Douglas-fir. This very same condition and scenario recently occurred one-half mile downcanyon to the north, where virtually all of the Douglas-fir on more westerly aspects in Lithia Park were destroyed. In this management area, Douglas-fir mortality is already occurring on more southerly and westerly aspects in adjacent Units D and E, with associated slopover of mortality into Unit B. Arresting this rapid mortality will be difficult to achieve because the stand has been too long in a suppressed, weakened condition; it can only slowly respond to the beneficial effects of reducing stand densities; and the beetle population is already well established, if not exploding. Nonetheless, reducing stand densities by manual thinning to release and improve the vigor of preferred leave trees is the only possible option for reversing this decline. The success of this endeavor will depend on a host of factors, the most important being the skill of the individuals doing the work, the climate within the several years on either side of the thinning operation, and the subsequent rapidity of spread of the bark beetle population. More productive areas with more vigorous individual trees (i.e., closer to the creek) will fare better than more suppressed portions of the stands. Ideally, stand basal areas can be reduced to 125 (±25) square feet per acre, with the thinning/release to largely be "from below," (i.e., removing the most suppressed, mostly pre-commercial conifers and hardwoods). However, it is estimated that perhaps 15 to 25 percent of total stand volumes in Unit 8 could be removed in a stand improvement harvest combining mortality (already dead but still merchantable) and sanitation (dying, diseased, defective, deformed) salvage with commercial thinning of merchantable, heavily suppressed conifers. Ideally, the commercial harvest would occur first so that smaller trees damaged during this operation could be removed in the subsequent non-commercial thinning/release operation. Unfortunately, time is of the essence in Unit B, as bark beetles are poised to destroy significant portions of the stands within the next several years. If this happens, not only would the City of Ashland lose a considerable potential financial resource, but more importantly would greatly increase the fire hazard and risk while also contributing to soil instability through subsequent loss of root strength. On the contrary, a well conducted stand density reduction would hopefully:

- maintain the most vigorous trees on site that could rapidly respond to thinning and subsequently progress to more fire resistant mature coniferous forest types;
- maintain deep-rooted, vigorous conifers that would continue to support healthy roots and subsequent slope stability;
- maintain an actively growing stand of high quality, high grade conifers that could represent an increasing financial value for the City (if desired);
- improve wildlife habitat, as stands were opened up, improving both species and structural diversity (both horizontal and vertical).

Harvesting would have to be done by helicopter to accomplish these multiple goals, although it is still questionable as to whether a feasible helicopter sale is possible because of small volumes of individual trees, small volumes per acre in a stand improvement harvest, and small total amounts of volume (unless incorporated with volume from other lands, either City-owned or neighbors).

An area-wide treatment of slash would obviously be the most desirable fuels management strategy, with all logging and/or thinning slash piled and burned. If this is not financially possible, concentrating piling and burning in the upper third of each slope should be prioritized. This would be particularly important within 100+ feet of each ridgeline where shaded fuelbreaks would be prioritized (in conjunction with adjacent Units C and E on more southerly aspects). The highest priority location for these shaded fuelbreaks are (1) at the major ridgeline at the top of Unit A in the northeastern corner of the property (associated with tops of subunits B_1, B_2, B_3, and B_4) and (2) between subunits B_2 and C_2.

Unit C - 10 acres

Description - Unit C is comprised of two subunits located in the very northernmost portion of the management area. These two subunits are located on 35 to 55 percent westerly to southwesterly aspects. These hotter, drier aspects generally have shallower soils than adjacent, more northerly aspects, and these conditions combine to encourage more drought-tolerant vegetation types. Whiteleaf manzanita dominates Unit C, mostly in solid brushfields up to 10 to 15 feet tall. It is suspected that these brushfields were initiated following either the 1900 or 1910 wildfires (most likely the 1910 wildfire). Incorporated within these brushfields are occasional hardwoods (California black oak and, particularly, Pacific madrone), and Ponderosa pine. These scattered Ponderosa pine (generally averaging around 50 trees per acre) are of variable ages and size, but typically range from 8 to 16 inches DBH and overtopping the existing brush. They are under considerable competition from the dense manzanita and many are likely candidates for mortality within the next 5 to 10 years if this condition does not change. Almost all of the Douglas-fir (less drought tolerant than Ponderosa pine) in Unit C have already died, and most have decayed to the point where they are no longer commercially viable. Estimated 100 year site index is 80 to 90 for Ponderosa pine.

Prescription - Hot, dry slopes like those in Unit C undoubtedly burned frequently prior to the advent of fire exclusion. As a result, they served a natural function as fuelbreaks and prevented development of larger scale, high intensity wildfires. In their current fuel condition, however, they are extremely flammable during the summer season and a significant wildfire hazard. Major fuel reduction in Unit C is imperative and should be a high management priority for the City-owned lands. This is particularly important because of their location on the north edge of the City ownership, which correspondingly is the lowest spot in the watershed. Hopefully, initial attack on a fire started within the city limits of Ashland (the most likely source for ignition) and spreading upcanyon (the most likely direction of spread in summer days) could contain a fire in this lower watershed area prior to developing into the type of massive fire that is difficult, if not impossible, to control. Management priorities in Unit C call for major fuel reduction by hand removal of 75 to 90 percent of the existing manzanita and hardwood cover. Complete clearing of manzanita should occur in at least a 20 to 30 foot radius around existing isolated Ponderosa pine. In places where the pines are more crowded, a maximum stocking level of 100 trees per acre (20 foot spacing) is desired. Scattered Pacific madrone and/or California black oak can be retained if they are not competing with preferred Ponderosa pine. Several narrow bands of hardwoods and brush can be strategically retained in the unit to provide for soil stability, erosion control to maintain vegetational and structural diversity and to promote habitat diversity for wildlife. However, brush and hardwood removal should be prioritized as a wildfire prevention activity first and foremost, and breaking up of horizontal fuel continuity is imperative. Once complete, Unit C can serve as a defensible fuel reduction zone, particularly in subunit C_2, where it will anchor into the proposed shaded fuelbreak on the ridge between subunits C_2 and B_2. Complete removal of manzanita should occur in a 75 to 100 foot swath along the ridgeline B_2/C_2 fuelbreak. All snags in the fuelbreaks should be felled (unless they can be economically retrieved in a timber sale planned for the remainder of the property), and piled and burned.

This extensive brushfield reclamation and fuel reduction can also serve as site preparation for planting of reduced levels of Ponderosa pine, perhaps on a 15-foot spacing. Control of incoming competitive weed species would be essential to insure survival of planted conifers. Ultimately, these would develop into overstory pine in a pine-savanna vegetation type that would remain much less fire prone than the existing dense brushfields. The seedlings will have to be carefully managed, however, to maintain their viability (control of competing vegetation) while insuring they don't contribute to fire hazard (pruning, pre-commercial thinning if necessary). It may be appropriate to experiment with planting native grasses (a much less volatile fuel type) in the new openings to discourage developing brush and hardwoods.

Unit D - 13 acres

Description - Unit D is comprised of two subunits located on 45 to 75 percent westerly slopes immediately above Ashland Creek. These locations near the canyon bottom are generally more productive than sites higher in the landscape. The 95-year-old conifers in these units reflect this, as diameters are significantly larger than elsewhere in the management area. Douglas-fir overstory trees 16 to 28 inches DBH are common. Unfortunately, stand densities have also historically been quite high until recently when bark beetles have initiated significant mortality. The combination of high basal areas, larger stems preferable to bark beetles, and an expanding bark beetle population encouraged development of a bark beetle epidemic in the Douglas-fir in portions of this unit. Approximately one-third of the basal area in Unit D (which averaged close to 200 square feet per acre prior to the initiation of beetle-induced mortality) has already died, mostly in expanding patches of mortality. Patches within these areas were originally logged in the 1990 helicopter logging, which retrieved this dead or declining timber, but obviously did little to improve stand health such that ongoing mortality could be reduced. It is expected that this trend will continue, with 5 to 20 percent of the remaining green Douglas-fir killed annually through the next several years. In addition, existing merchantable dead trees will continue to decay and lose potential commercial viability, as well as significantly contribute to wildfire hazard in the area. With the significant mortality in Unit D, basal areas currently average 125 to 150 square feet per acre, although mortality is complete in several 1 to 2 acre patches of merchantable Douglas-fir. These openings, coupled with the often-associated helicopter logged patches have become rapidly revegetated with dense creeping snowberry, grasses, forbs, and other plants. Elsewhere in the unit where mortality has not been as significant, Douglas-fir still comprises two-thirds or more of the stand basal area, with Pacific madrone the next most common tree (15 to 20 percent of stand basal area). Typical of these types of dense stands in the management area, understory vegetation is sparse. Estimated 100 year site index is 110 to 120 for Douglas-fir, indicative of the high productivity of these sites. Given this high productivity, the ongoing demise of Douglas-fir is that much more unfortunate.

Prescription - The coniferous stands in Unit D are in a rapid state of decline, with at least one-third of the stand already killed by the advancing bark beetles. Reversing this trend in the remainder of the stand will be difficult at best, but basically involves stand density reductions to try to optimize residual tree vigor. A fair number, perhaps 5 to 10 percent of the original stand, have died since the 1990 helicopter logging and are too far gone to be commercially viable. Some of these (4 to 7 per acre) could be maintained as snags for wildlife (this area is not as serious of a fire hazard as higher on the landscape), although this hazard may conflict with recreational use of the area (an apparently new trail has been created that starts in subunit D_1, traverses until it reaches the B_2/C_2 ridge, then follows that ridge up to the Alice in Wonderland trail on top of the main ridge). Ideally, the remaining dead merchantable trees could be removed in timber sale(s) prior to their decay and ultimate commercial uselessness. Several old roads parallel the main road up the canyon and allow access for harvest and removal of perhaps one-quarter to one-third of the standing dead volume by ground-based logging systems. (An in-depth discussion of the pros, cons, and potential impacts of logging using ground-based logging systems in a similar situation was prepared by the author for the City of Ashland in "Silvicultural Prescriptions for Two City of Ashland Owned Parcels," 1995.) The steep slopes would allow little opportunity for log skidding off of these old skid roads, however, thereby requiring the use of helicopters throughout the remainder of the unit. In portions of the unit that still support green Douglas-fir, a combination of mortality/ sanitation salvage and commercial thinning combined with non-commercial thinning and release treatment could initiate the stand density reduction necessary to hopefully retain some of the larger size classes in the unit. Some of this material may be available for utilization as firewood given its close proximity to the main Ashland Creek canyon road. The large bulk of the slash will have to be piled and burned, however. Good slash treatment and overall fuel reduction are important in this unit because of the heavier concentrations of people (workers, vehicles on the road, hikers and mountain bikers, etc.) and subsequent greater potential for ignition source. These steep slopes are particularly prone to mass soil movements, particularly given the ongoing mortality of the deep-rooted overstory conifers. In those areas where the conifers have already been removed by bark beetles, however, spot planting of Douglas-fir on a 12-foot spacing should be undertaken to quickly re-establish deep-rooted conifers in these steep portions of Unit D. Control of competing vegetation in a 3 to 4 foot radius around each seedling will be imperative for seedling survival.

Unit E - 28 acres

Description - The highly dissected topography typical of the erosive granitic parent materials found in the management area produces the series of adjacent and opposing aspects and subsequent site conditions described in this report. Unit E comprises 4 subunits in this series located on 35 to 65 percent westerly to southwesterly aspects and adjacent the opposing northerly aspects of Unit B. These hotter, drier sites are very similar to those in Unit C and site productivities are similarly reduced. However, unlike Unit C, where whiteleaf manzanita thoroughly dominates the sites, vegetation in Unit E is more diverse. Unlike Unit B where stand replacement fires in 1910 created a single even-aged stand of Douglas-fir, Unit E is dominated by several age classes and species of trees, with each age class largely initiated after one of a series of disturbances. The generally reduced amounts of vegetation and subsequent fuel loads on these less productive sites encouraged fires of reduced intensity, with patches of overstory conifers escaping mortality in each disturbance event. Thus, the existing stands in Unit E much more closely resemble an "uneven-aged" stand configuration. Scattered throughout Unit E are 1/4 to one-acre pockets of older Douglas-fir and Ponderosa pine 125 to 200 years old (it appears that at least several fires occurred during this period, with perhaps the most significant fire occurring approximately 150 years ago, as this age class is the most common of these larger trees) and 18 to 30 inches DBH. These are trees that escaped fires and logging activity. They are seldom contiguous patches, however, as numerous conifers and hardwoods have invaded since the last fire 85 years ago, severely threatening the long-term viability of these scattered trees. Invariably, these trees are in poor to fair (at best) condition, commonly averaging 30 to 50 rings per inch or more. A number of these were also removed during the 1990 helicopter logging, possibly as mortality salvage at that time. Most of the overstory conifers in Unit E, however, are 85 to 95 years old, having been initiated following the major fires in 1900 and 1910. These trees are typically 10 to 18 inches DBH. Logging of scattered larger merchantable conifers appears to have occurred throughout Unit E in the late 1930s (conifers in adjacent Unit B were mostly too small to be merchantable at that time). Openings created during this harvest, coupled with the greater abundance of non-stocked openings on these harsher sites, has allowed establishment of smaller advanced regeneration of Ponderosa pine, Douglas-fir, hardwoods, and brush species (primarily whiteleaf manzanita and occasional deerbrush ceanothus, mountain mahogany, oceanspray, and other less common species). Unfortunately, in the absence of fire in the last 85 years, the hardwoods (primarily Pacific madrone and California black oak) and brush species have become much more abundant, contributing to a much more continuous fuel complex (both horizontally and vertically) throughout the unit and competing with the existing conifers for site resources. Numerous overstory Douglas-fir (both merchantable and pre-merchantable) have died in Unit E, although not to the extent as is currently occurring in Unit D. The greater abundance of openings (often now dominated with brush) reduced site productivities, and history of logging and bark beetle induced mortality has resulted in reduced stand basal areas—typically averaging 75 to 100 square feet per acre in non-brushfield areas. Douglas-fir, Ponderosa pine, and hardwoods (particularly Pacific madrone) generally comprise equal portions of that total stand basal area, although this can vary dramatically from microsite to microsite. Ponderosa pine invariably appears to be more vigorous and healthy than Douglas-fir. Incense cedar (primarily in the understory) and sugar pine (primarily in the overstory as rare large dominant trees) also occur. Understory vegetation is more common on these more open sites and includes more abundant grass, forbs, and tall Oregon grape, as well as the aforementioned brush species. One hundred year site index is 95 to 105 for Ponderosa pine, 85 to 100 for Douglas-fir.

Prescription - Prior to the era of fire exclusion and subsequent dramatically increased fuel levels, the harsher sites and reduced levels of vegetation in Unit E (like Unit C) acted as natural fuelbreaks on a landscape level. With more frequent, low intensity fire, slow growing hardwoods (when initiated from seed) and brush species were unable to dominate sites as they do currently in Unit E. A return to these conditions would significantly reduce the likelihood, as well as intensity and rate-of-spread, of a wildfire. In addition, established conifers, particularly Ponderosa pine, would garner a greater percentage of site resources (most importantly, water) and be considerably more vigorous, thereby resisting bark beetle attack and adding volume onto larger, more thrifty trees. Stand density reduction through manual release operations, coupled with removal of competing brush species, would achieve these desired future conditions. Ponderosa pine and sugar pine would be preferred leave trees throughout Unit E, although maintaining a diversity of species and age classes is certainly possible and even desirable. Thinning slash should be piled and burned, or perhaps prescribed underburned, with particular emphasis on ridgeline locations (similar to that described for fuelbreaks in Unit C). Existing merchantable dead or dying, deformed, defective, diseased, or heavily suppressed conifers can be removed in a helicopter logging wherever volume is clustered enough to warrant their economic removal (provided a property-wide helicopter sale can be developed and sold). Treatment of subunit E_3 is of particular priority because it is larger and wider than the other subunits and would offer the most significant defensible fuel reduction zone. The bottom, most westerly part of this subunit is a particularly harsh site with an inherent reduced amount of vegetation, making establishment of a good fuel reduction zone through this area that much more feasible. Too, treatment of subunit E_3 would tie into the existing defensible fuel reduction zone on private land just east of the property, providing a significant 600-foot wide fuel reduction zone, running close to one-half mile wide in an east to west direction.

Unit F - 4 acres

Description - Unit F is a unique unit in the management area. It is located on 35 to 55 percent southerly aspects and, given this location, could have been included as a subunit of Unit C or perhaps more appropriately Unit E. Unit F was apparently burned in both fires around the turn of the century (the 1900 event and the 1910 event), as trees of both ages were found. Unlike the rest of Unit C or Unit E, however, these trees developed into a fairly contiguous stand dominated primarily by conifers. Currently 300 to 500 trees per acre comprise an average stand basal area of 175 square feet per acre. Ninety percent of that total is comprised of conifers—Douglas-fir (about 60 percent) and Ponderosa pine (about 30 percent), mostly in the 10 to 18 inch DBH size class. This high percentage of well developed conifers of merchantable size classes and corresponding low percentage of hardwoods (primarily Pacific madrone and to a lesser extent California black oak) is unusual on these aspects in this management area—hence, its delineation as a separate unit. It does point, however, to the potentials for stand development that are possible if conifers can gain early establishment at full stocking levels (unlike Units C and E) and develop without becoming stagnant (as in Unit B). Nonetheless, the unit is considerably overstocked, as evidenced by poor crowns (although not as reduced as in Unit B), slow growth rates (typically 25 to 40 rings per inch, even in the overstory dominant trees), and beginning in-stand mortality. However, adjacent the powerline easement (where all trees were removed approximately 23 years ago), the positive effects of stand density reduction were obvious. One vigorous, 20 inch DBH Ponderosa pine was immediately released at the time of clearing for the powerline and instantly improved its growth rate from 25 to 7 rings per inch. This is the type of leave tree response desired throughout Unit F, as well as throughout the management area as a whole. Understory vegetation is sparse underneath this dense stand, and few developing coniferous seedlings or saplings exist. One hundred year site index is 95 to 105 for Ponderosa pine; 90 to 100 for Douglas-fir.

Prescription - Unlike most of the southerly to southwesterly aspects in the management area, the stand in Unit F is not only contiguous, but contains a number of overstory dominant conifers in fair to good condition. Even though located on harsher sites than those in adjacent Unit B, the reduced number of trees per acre (300 to 500 as opposed to 800 to 1,000 in Unit B) allowed those trees to grow faster, more vigorously, and to larger sizes in the same time period. Less mortality from bark beetle infestation is a subsequent benefit of these healthier stand conditions. Nonetheless, the stand is currently considerably overstocked, of reduced vigor, and available to additional bark beetle induced mortality, particularly given the beetle population and extensive overstory mortality in adjacent subunit D_1. Therefore, a reduction in stand density is imperative to prevent further decline of this stand. The larger size classes in this stand (and the reduced number of hardwoods and brush species) suggest that the type of non-commercial release treatments suggested for elsewhere on southerly aspects would not reduce stand densities to the desired basal areas of 100 to 125 square feet per acre. Commercial thinning as part of a larger helicopter sale in the area is the most feasible way to accomplish the needed stand density reduction in this unit. Removal of merchantable dead, dying, diseased, defective, or heavily suppressed conifers should be accomplished at the same time. The key to successful stand improvement in this situation is to retain the most vigorous conifers in the stand, which are almost invariably the largest. Treatment of ensuing slash could be accomplished through pile and burning or prescribed underburning. This would be a particularly good location for a prescribed underburn, particularly if a well developed and implemented fuelbreak (a high priority) on the ridge above (Unit C_1) is in place. The ensuing stand condition (provided it is accomplished prior to excessive additional bark beetle induced in-stand mortality) would be a model of future desired conditions for vegetation on these aspects, particularly from a fuel management or wildfire prevention perspective.

PRIORITIZATION OF NON-COMMERCIAL SILVICULTURAL ACTIVITIES*
Listed in order of importance

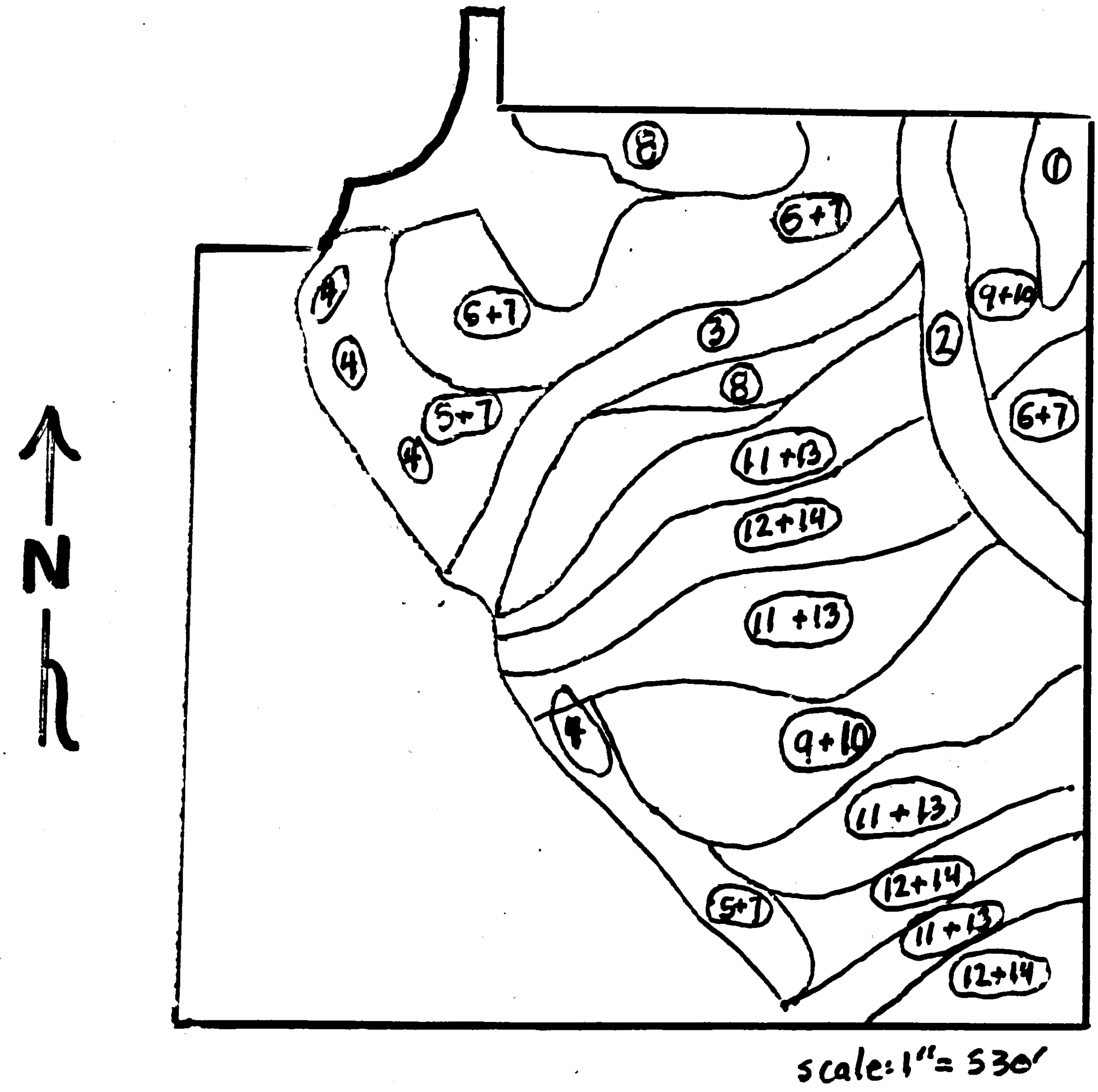
Unit or Subunit	Activity	Acres	Cost per Acre	Total Cost
1. A_1	Burn piles, plant seedlings in openings	3	$300-600	$900-1,800
2. A_2/B_1	Shaded fuelbreak construction—thin, pile, burn	7	$1,000-1,300	$7,000-9,100
3. B_2/C_2	Fuelbreak construction—thin and brush, pile, burn	9	$1,100-1,400	$9,900-12,600
4. D	Plant 400 conifers per acre in unstocked openings, control competing vegetation	4	$325-425	$41,300-1,700
5. D	Non-commercial release treatment	13	$250-350	$3,250-4,550
6. B_1, B_2	Non-commercial thin & release	19	$250-350	$4,750-6,650
7. D, B_1, B_2	Pile and burn slash; utilize where possible.	32	$300-600	$9,600-19,200
8. C_1, C_2	Brushfield reclamation—brush, pile, burn, plant	9	$1,300-1,600	$11,700-14,400
9. E_2, A_2	Non-commercial thin and release	17	$250-350	$4,250-5,950
10. E_2, A_2	Pile and burn slash	17	$300-600	$5,100-10,200
11. B_3, B_4, B_5, B_6	Non-commercial thin and release	23	$250-350	$5,750-8,050
12. E_1, E_3, E_4	Non-commercial thin and release	14	$250-350	$3,500-4,900
13. B_3, B_4, B_5, B_6, E_1, E_3, E_4	Slash treatment—pile and burn and/or prescribed underburn	37	$300-500	$11,100-18,500
			TOTAL:	$77,700-116,800

* See map for location of activities.

PRIORITIZATION OF NON-COMMERCIAL SILVICULTURAL ACTIVITIES
Listed in order of importance

Unit or Subunit	Activity	Acres	Cost per Acre	Total Cost
1. A_1	Burn piles	3	$250-500	$750-1,500
2. A_2/B_1	Shaded fuelbreak construction—thin, pile, burn	7	$1,000-1,300	$7,000-9,100
3. B_2/C_2	Fuelbreak construction—thin and brush, pile, burn	9	$1,100-1,400	$9,900-12,600
4. D	Plant 400 conifers per acre in unstocked openings, control competing vegetation	4	$325-425	$41,300-1,700
5. D	Non-commercial release treatment	13	$250-350	$3,250-4,550
6. B_1, B_2	Non-commercial thin & release	19	$250-350	$4,750-6,650
7 D, B_1, B_2	Pile and burn slash, utilize when possible	32	$300-600	$9600-19200
7. C_1, C_2	Brushfield reclamation—brush, pile, burn, plant	9	$1,300-1,600	$11,700-14,400
8. E_2, A_2	Non-commercial thin and release	17	$250-350	$4,250-5,950
9. E_2, A_2	Pile and burn slash	17	$300-600	$5,100-10,200
10. B_3, B_4, B_5, B_6	Non-commercial thin and release	23	$250-350	$5,750-8,050
11. E_1, E_3, E_4	Non-commercial thin and release	14	$250-350	$3,500-4,900
12. B_3, B_4, B_5, B_6, E_1, E_3, E_4	Slash treatment—pile and burn and/or prescribed underburn	37	$300-500	$11,100-18,500
			TOTAL:	$67,950-97,300
				9600-19200
				77550-116500

PRIORITIZATION OF NON-COMMERCIAL SILVICULTURAL ACTIVITIES



scale: 1" = 530'

prepared by: Marty Main
Small Woodland Services Inc
2/96

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[illegible] Woodland Services, Inc

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COMMERCIAL SILVICULTURAL ACTIVITIES

City of Ashland personnel responsible for the management of lands addressed in this report should consider exploring the possibility, and feasibility, of a timber harvest to remove merchantable dead and dying conifers and to improve stand conditions.

A small timber sale using ground based logging systems could be conducted from established roads and quarries in the bottom of Ashland Creek canyon. This could retrieve dead and dying volume primarily in Unit D and perhaps small portions of Units B and/or E. Logging equipment would be largely restricted to existing roads, quarries, and old pre-existing skid roads. The sale would be a small one—perhaps 5,000 to 25,000 board feet and be relatively easy to undertake. The costs of such a logging would range from $200 to $400 per thousand board feet.

Helicopter logging will be needed to conduct mortality-sanitation salvage and stand improvement harvesting throughout almost the entire management area addressed by this report. Helicopter logging must be done on a much larger scale than ground-based logging, largely due to the extreme high costs of operating a helicopter and subsequent economies of scale. It is debatable whether sufficient volumes could be generated in the management area alone to justify a helicopter timber sale. Rough estimates suggested 150,000 to 250,000 board feet could be generated in a stand improvement/salvage harvest within the management area. Contrast this figure with the 1,400,000 board feet removed in the 1990 logging operation in the general vicinity on City of Ashland and adjacent private lands. Including additional volume from City of Ashland owned lands and/or other adjacent private lands is certainly prudent, and may be necessary in order to generate a timber sale using helicopters.

Planning for a helicopter sale is also more complex and time consuming, particularly when stand improvement objectives are prioritized. The timber volume would have to be marked and cruised prior to being shown to prospective logging contractors and/or potential purchasers. There are far fewer helicopter logging contractors and subsequent increased likelihood that a sale could remain unsold, especially if the sale contains smaller total volumes.

As to be expected, the cost of helicopter logging can be much more variable, with ranges from $250 to $500 per thousand board feet (if the sale is sold at all) delivered to mill. Log prices in the last several years for second growth Douglas-fir have ranged from $650 to $800 per thousand board feet delivered at mill.

OTHER NEEDED MANAGEMENT ACTIVITIES

Develop restoration/maintenance plan for granite quarries and roads; hire consulting engineering geologist.

Develop proactive recreation management plan for management area.

Maintain 4 to 7 snags per acre in non-fuel treatment areas.

Coordinate with U.S. Forest Service in development of watershed level planning for multiple resource values (wildfire prevention, wildlife habitat, aquatic and riparian management, recreation management, etc.)

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