Silver Lake RD

Upper Sycan Watershed

Ecosystem Analysis at the Watershed Scale

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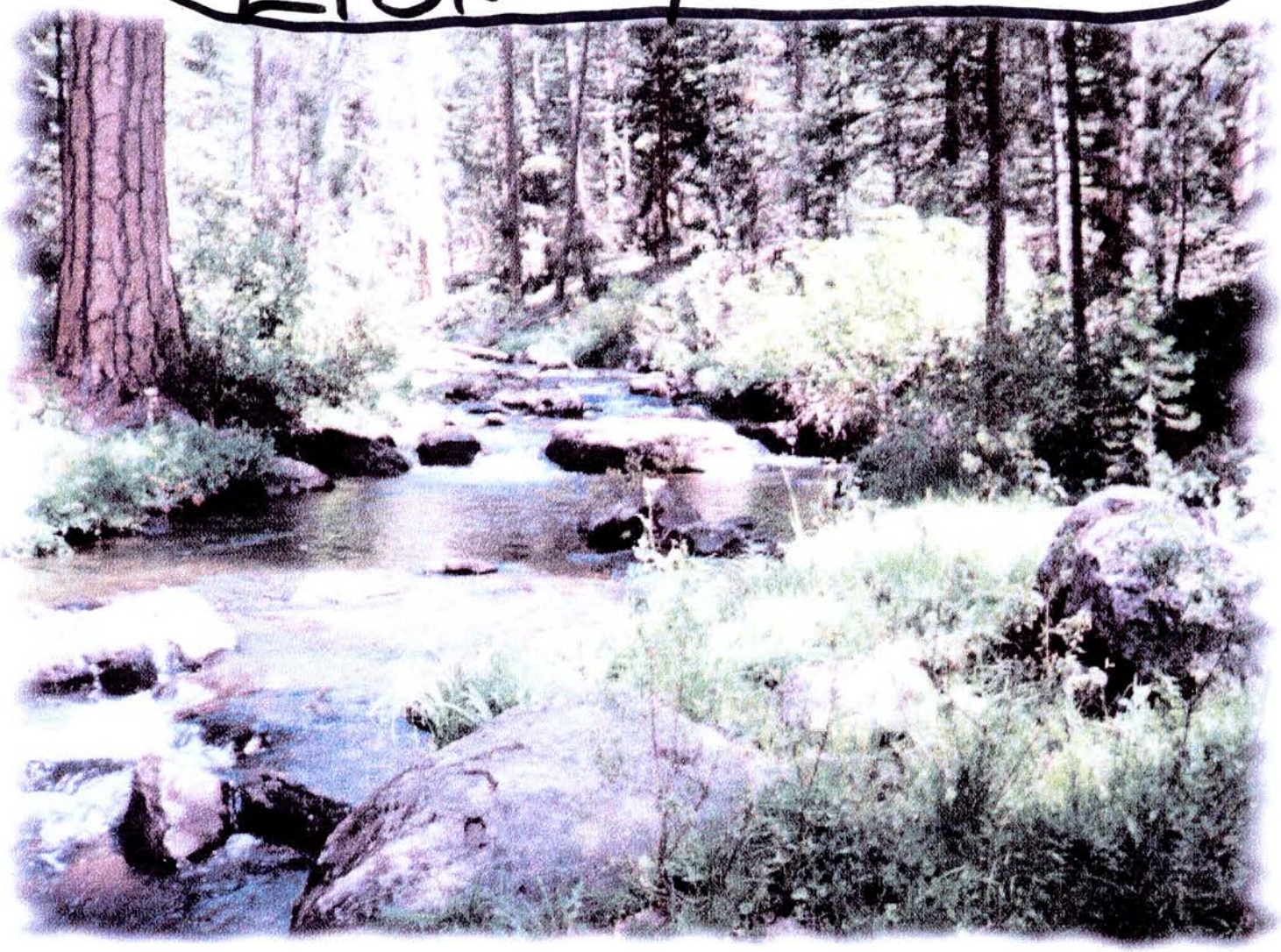

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Fremont National Forest

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Upper Sycan Watershed Analysis

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INTRODUCTION

Watershed analysis is a process used to characterize the human, biological and physical conditions, processes, and interactions within a watershed. By looking at the ecosystem as a whole, the analysis provides a systematic way to understand and organize ecosystem information. Watershed analysis is an intermediate analysis between land management planning and project planning. It helps us understand how past land use activities interacted with the physical and biological environments in the landscape. The analysis focuses on specific issues, values and uses identified within the landscape that are essential for making sound management decisions. This document presents a current understanding of the processes and interactions of concern occurring within the Upper Sycan watershed.

A ten-member team from the Silver Lake and Paisley Ranger Districts and the Headquarters of the Fremont National Forest conducted this analysis. The team members consisted of a silviculturist, wildlife biologist, ecologist, civil engineering technician, fuels specialist, hydrologist/aquatic specialist, range conservationist, archeologist, cultural resources/recreation technician and a team leader (see Appendix D). The Upper Sycan Watershed is situated on the Paisley Ranger District of the Fremont National Forest.

The team followed the six-step process as outlined in the Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis. This process includes:

Step 1 - **Characterization** of the watershed – a summary of the dominant conditions and interactions within the watershed

Step 2 - Identification of **issues** and key questions

Step 3 - Description of **current conditions**

Step 4 - Description of **reference conditions** - in general this is the historical condition, prior to the influence of European settlement. Since historical conditions for hydrologic parameters are generally not available, the "Watershed and Aquatics" sections of this document will focus on "desired condition" (see Step 4, page 1).

Step 5 - **Synthesis and interpretation** of information – a comparison of current and reference conditions including discussion of similarities, differences, causes and trends

Step 6 - Management **recommendations**.

This six-step process has been used for watershed analysis during the past 5 years on the Fremont National Forest. In watershed analysis, each step focuses on core topics. Readers of this document accustomed to the topic organization of recent Watershed Analyses will note some differences in the organization of this document. A new organizational approach, within the framework of the six-step process, has been used for presenting information on hydrology and aquatic function and condition. In order to present hydrologic and aquatic analysis in a more integrated fashion, core topics relating to watershed and aquatics are presented under just three headings: (a.) uplands, (b.) riparian vegetation and stream channels and (c.) aquatic habitat. In previous documents produced on the Fremont National Forest, information on these topic areas was divided amongst six or seven headings.

This document is organized by "**Steps**". Since the document is structured in relation to the six steps, rather than in relation to the core topics, it is often necessary for the reader to move from one step to the next in order to gain the complete "story" in relation to a given core topic. In order to assist such a search, a unique two-part number which reports step and page number within that step can be used to identify each page. For example, (3 – 7) would be the 7th page in Step 3, Current Conditions. References are included throughout the document, using this "(Step-Page Number)" format, in order to assist the reader in locating closely related material.

This document presents the information gathered by the ten-member core team. It is not a decision document under the National Environmental Policy Act (NEPA), nor does it initiate or result in land management allocations. It does not select specific projects for implementation. The Paisley Ranger District will use this analysis to determine which specific projects would move the watershed toward the desired condition described in the Land and Resource Management Plan, Fremont National Forest, as amended. Such projects will be analyzed separately by a district interdisciplinary team. Project analysis will include involvement by the public and result in a site-specific decision as required by the National Environmental Policy Act.

General Watershed Area

The Upper Sycan Watershed, from the Sycan Marsh to the west, Shake Butte, Black Butte and Green Mountain to the southwest and Winter Ridge to the east is characterized by gentle topography with a majority of the landscape having a west or northwest aspect. Most of the major topographic features occur along the divides between the Upper Sycan watershed and adjacent watersheds. The only major topographic feature that is interior to the watershed is Taylor Buttes, in the Paradise Creek subshed. Elevations range from approximately 5,015 feet near the edge of Sycan Marsh to 7,565 feet on Winter Ridge. Steeper slopes occur along the canyon of the Sycan River and along peaks and ridges such as Shake Butte, Taylor Buttes and Green Mountain.

The headwaters of the Sycan River occur on the high rim known as Winter Ridge, approximately 11 miles west-southwest of Paisley, Oregon. The Upper Sycan Watershed is located in the northwestern portion of the Paisley Ranger District and includes three sub-watersheds, or "subsheds". These subsheds include Upper Sycan River, Long Creek and Paradise Creek. The watershed drains into, and is a significant contributor to, the Sycan Marsh -- a large wetland comprised of marshy and forested wetlands. Paradise Creek and Long Creek are the two major tributaries to the Sycan River in the area above the Marsh. Paradise Creek flows generally north from the divide formed by Shake Butte, Black Butte, Green Mountain and the ridge running east from Green Mountain that separates this watershed from the North Fork Sprague River. The confluence of Paradise Creek and the Sycan River occurs just above Pike's Crossing, approximately 11 miles above Sycan Marsh. Long Creek flows generally west, from a portion of Winter Ridge in the northeast part of the watershed. The confluence of Long Creek and the Sycan River occurs approximately 4 miles above the Marsh.

The vegetation types consist of meadow, grassland/shrub non-forested uplands, ponderosa pine, lodgepole pine, mixed conifer, juniper woodlands and stream edges vegetated with willows, alder, and other deciduous shrubs.

The watershed area totals approximately 65,700 acres (actual figure in the GIS database is 65,712 acres). About 56,400 acres (86%) are managed by the USDA Forest Service, with the remaining 9,300 acres (14%) being privately owned. All statements which report area (typically in acres) refer to both public and private area, unless otherwise stated. Frequently information was only available or gathered on National Forest lands and therefore phrases such as "...of National Forest lands.." are found in abundance. In the desire to display as much information as possible, information on private lands is included where available.

Geology and Soils

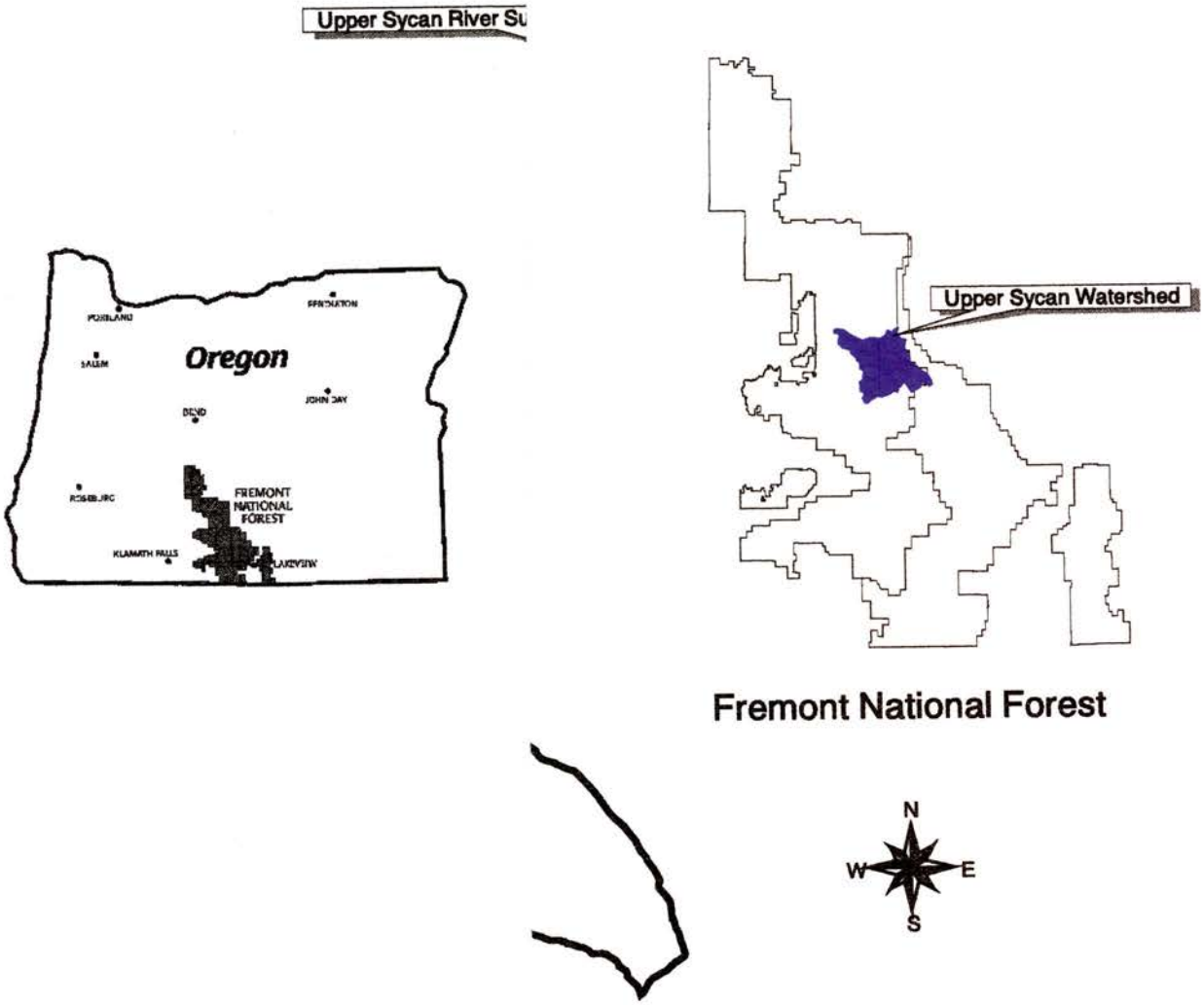
The Upper Sycan Watershed lies at the far northeastern point of the Klamath Basin province. The geomorphology of the Upper Sycan River Watershed is characterized by northwest trending fault blocks (Winter Ridge) interspersed with conical or irregularly shaped volcanic features (Shake Butte, Green Mountain, Taylor Buttes, Bald Butte, etc.). Most of the soil lying beneath the forest and shrub litter is derived from igneous rocks--which were ejected from small volcanoes and solidified from a molten state. Soils found in the watershed are the result of several factors: parent material, topography, climate, organisms, and time. These factors have interacted to produce four basic groups of soils:

- Alluvial soils
- Basalt, andesite, and tuff derived soils associated with eruptive centers
- Rhyolite derived soils associated with wind-carried Mazama ash and pumice
- Wind-carried Mazama ash and pumice soils over buried basalt/andesite derived soils

These groups are different in their physical and chemical properties, and therefore, different in their susceptibility to erosion and compaction and their capacity for water infiltration and heat exchange. Additional information on the properties of these soil groups can be found beginning on page (1-1).

Climate

The watershed stands in the shadow of the Cascade Mountains to the west. The Upper Sycan Watershed receives rain and snow, totaling between 15-35 inches of precipitation each year, depending on elevation. Winter temperatures drop below 0°F. Even during the summer, frost and snow may occur at higher elevations. Convective thunderstorms provide rain in spring and summer.


Upper Sycan River Su
Oregon
PORTLAND
SALEM
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JOHN DAY
ROSEBURG
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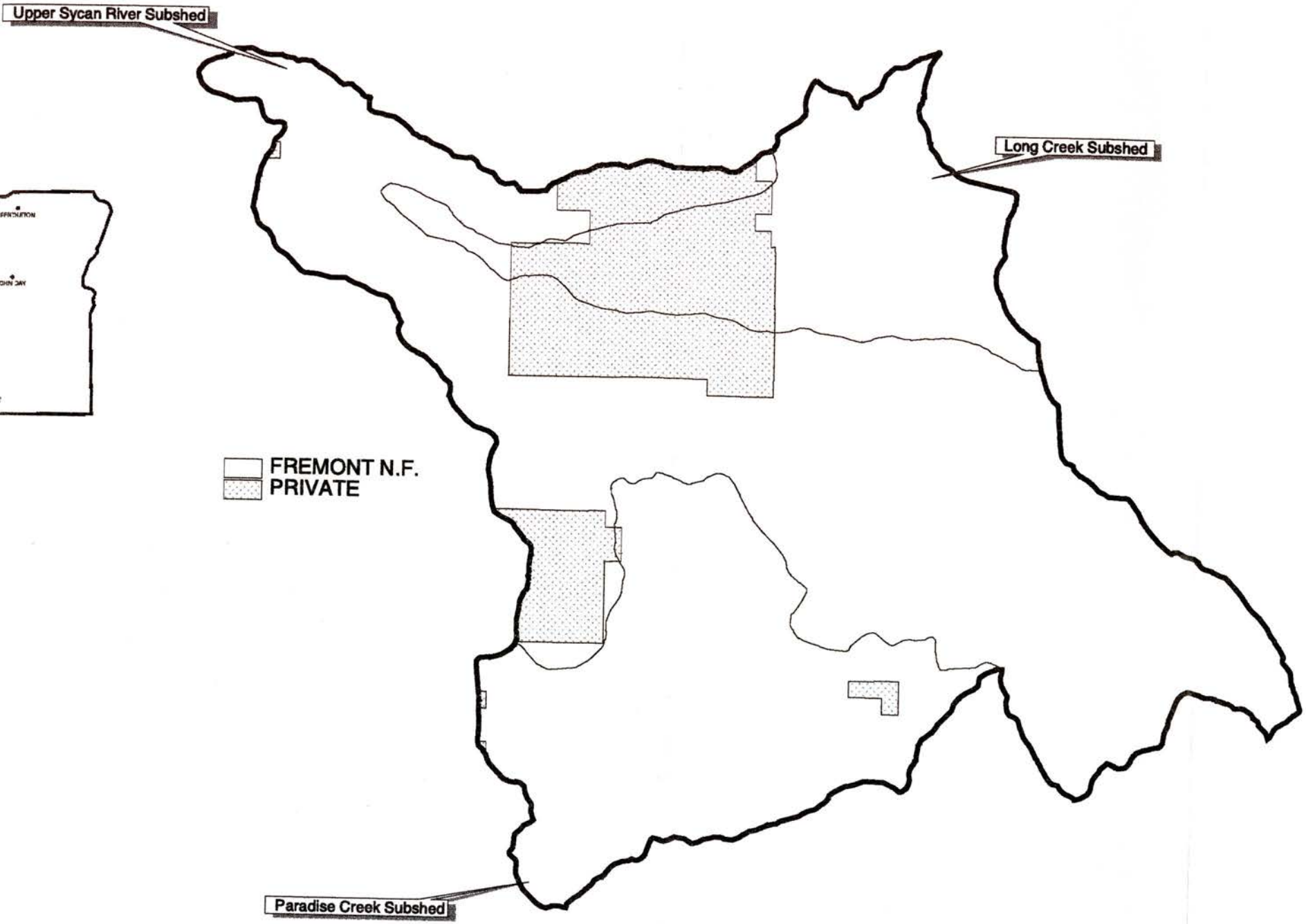
Upper Sycan Watershed



STEP 1. CHARACTERIZATION OF THE WATERSHED

The characterization identifies the dominant physical, biological, and human processes and features of the watershed that affect ecosystem functions and conditions. This section identifies the primary ecosystem elements needing more detailed analysis in subsequent sections. Additional detail on the current condition of these elements is included in Step 3.

I. Watershed and Aquatics

The Upper Sycan Watershed is located in the northwestern portion of the Paisley Ranger District and includes three subwatersheds: Paradise Creek, Long Creek and Upper Sycan River. The watershed drains into, and is a significant contributor of, the Sycan Marsh -- a large wetland comprised of palustrine emergent and forested wetlands. Sycan Marsh has one of the highest breeding bird and mammal densities in Oregon and is an important late summer water source in the Upper Klamath Basin.

Uplands

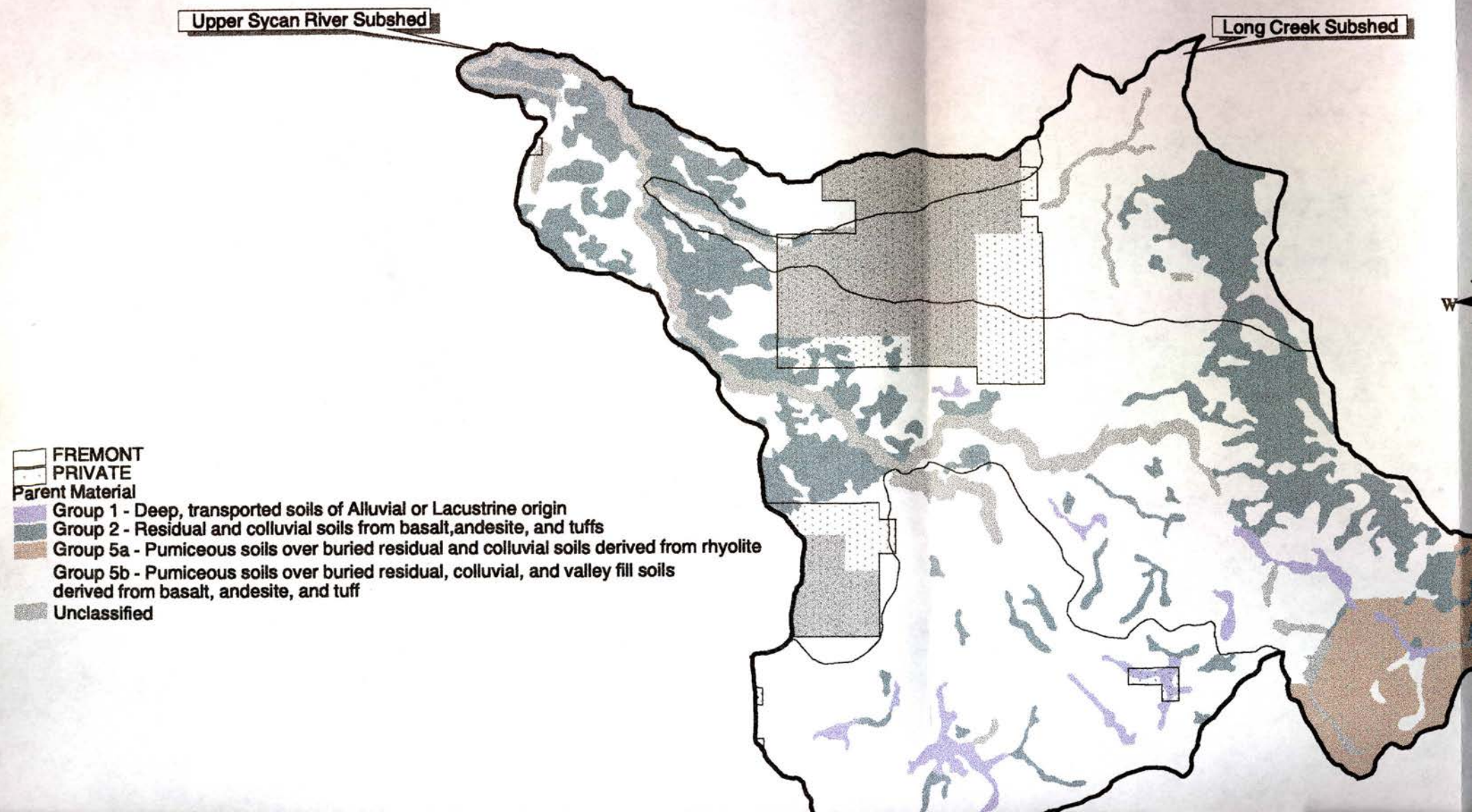
As in other regions, watershed hydrology in the Upper Sycan Watershed begins with climate. Local weather is influenced to a large degree by the Cascade Mountains. The eastern peaks of the Upper Sycan lie east of the Cascade Mountains, within view of Crater Lake National Park and Mount McLoughlin. This mountain range lifts and blocks the maritime air masses that move eastward from the Pacific Ocean, inducing rain and snow to blanket its slopes. The watershed stands in its shadow, receiving leftover rain and snow, about 15-35 inches each year depending on elevation. The majority of precipitation falls as snow from October through March, with the highest elevations receiving the greatest depths and winter temperatures dropping below 0°F. Even during the summer, frost and snow may occur at these elevations. Convective thunderstorms provide rain in spring and summer, although the summer months are relatively dry. Higher elevation areas have a progressively shorter growing season, with the growing season being significantly shorter above 6,500 feet elevation where ponderosa pine becomes less common. Rain or snow is captured (intercepted) by juniper and sagebrush along the lower scabland plateaus, by ponderosa pine in the lower to middle elevations, and by white fir and lodgepole forests in the upper elevations. Some of this intercepted water evaporates, while the remainder soaks into the soil. The best infiltration occurs when needles and leaves cover the soil, slowing surface runoff and allowing the water to enter the ground.

The Upper Sycan River Watershed, from the Sycan Marsh to the west, Green and Bald Mountains to the south and Winter Ridge to the east is characterized by gentle topography. The slope on about 62,500 acres (95% of the area) is between 0 and 20%, while only 3,160 acres (5% of the area) have slopes over 20%. The few areas with steeper slopes occur along the canyon of the Sycan River and along peaks and ridges such as Shake Butte, Taylor Buttes and Green Mountain. Elevation ranges from approximately 5,015 to 7,560 feet with the majority (51%) of the watershed having a west aspect.

Northwest trending fault blocks (Winter Ridge) interspersed with conical or irregularly shaped volcanic features (Shake Butte, Green Mountain, Taylor Buttes, Bald Mountain, etc.) characterize the geomorphology of the Upper Sycan River Watershed. Most of the soil lying beneath the forest and shrub litter is derived from igneous rocks--which were ejected from small volcanoes and solidified from a molten state. The kinds of soils found in the watershed are the result of several factors (parent material, topography, climate, organisms, and time), which have interacted to produce four basic groups. These groups are different in their physical and chemical properties, and therefore, different in their susceptibility to erosion and compaction and their capacity for water infiltration.

> The first group of soils is derived of alluvial materials--those materials transported and deposited by water--occurring along major streams, valleys, and bottomlands. The meadows along the Sycan River, Paradise Creek, Watson Creek, Crazy Creek, and Skull Creek possess these types of soil. Because they occur adjacent to moving water, they are highly susceptible to gully erosion and eventual downcutting.

Fig. 1.1 Parent Material Of Soils in the Upper Sycan Watershed



the Upper Sycan Watershed

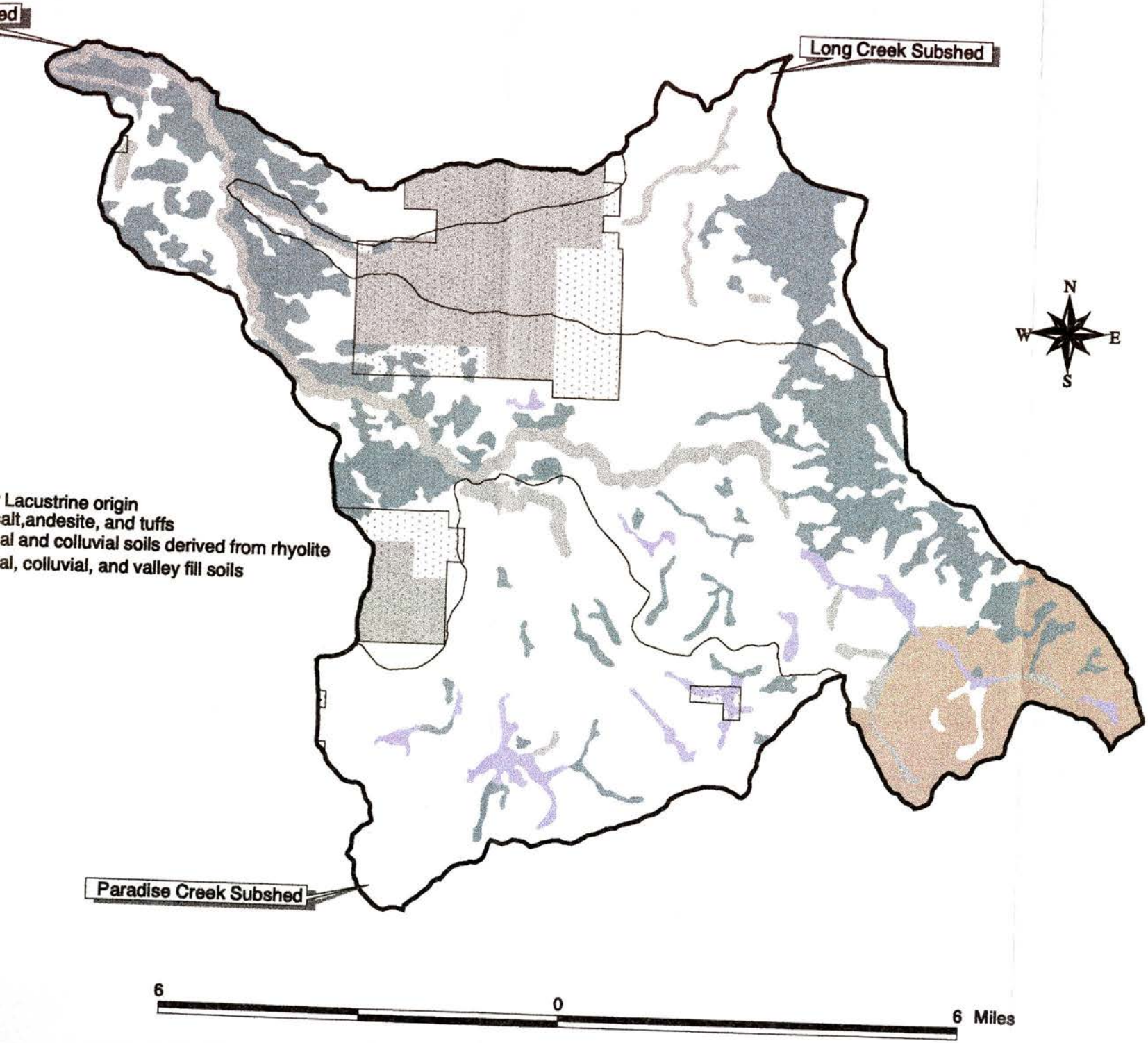
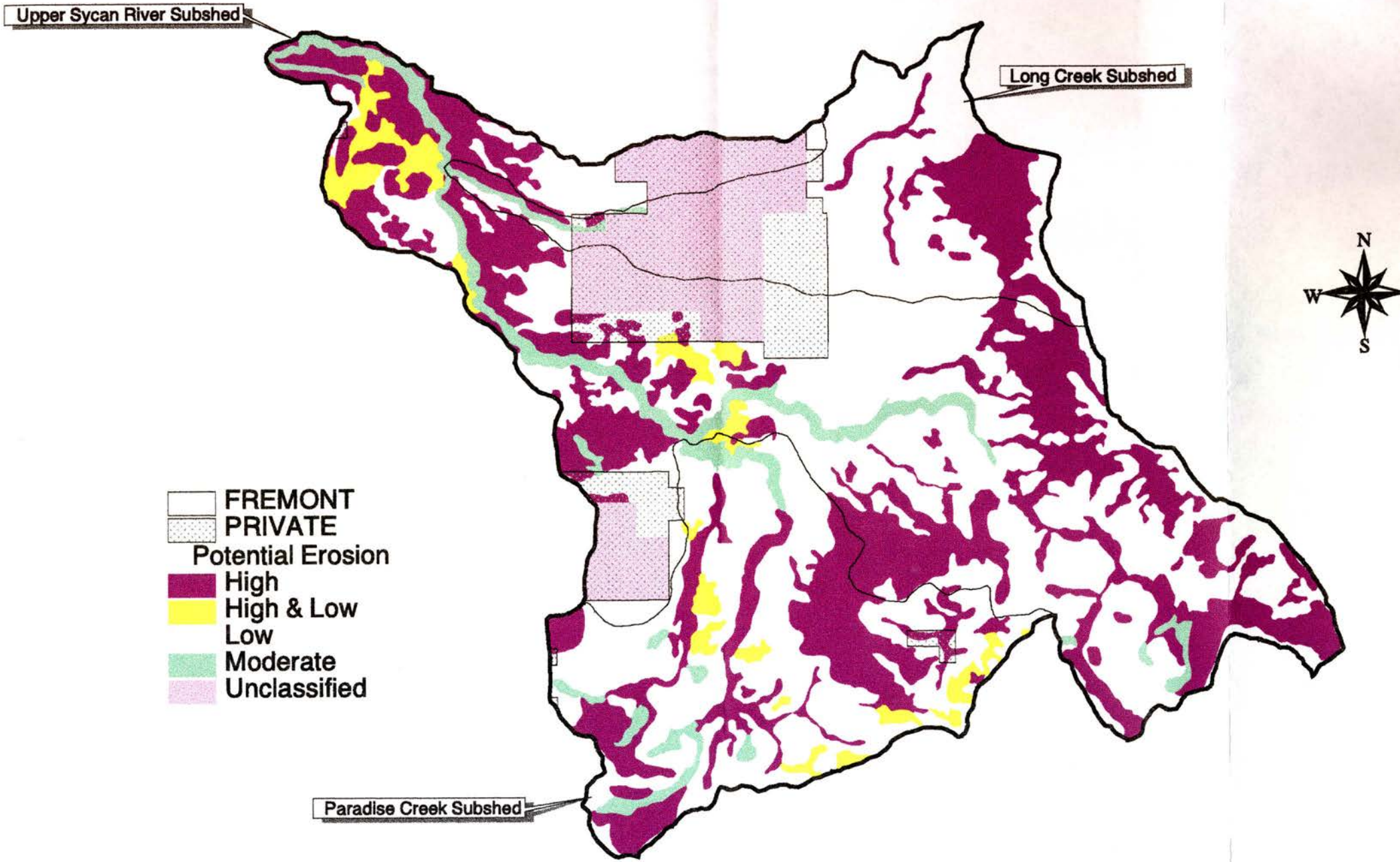


Fig. 1.2 Erosion Potential in the Upper Sycan Watershed



Upper Sycan Watershed

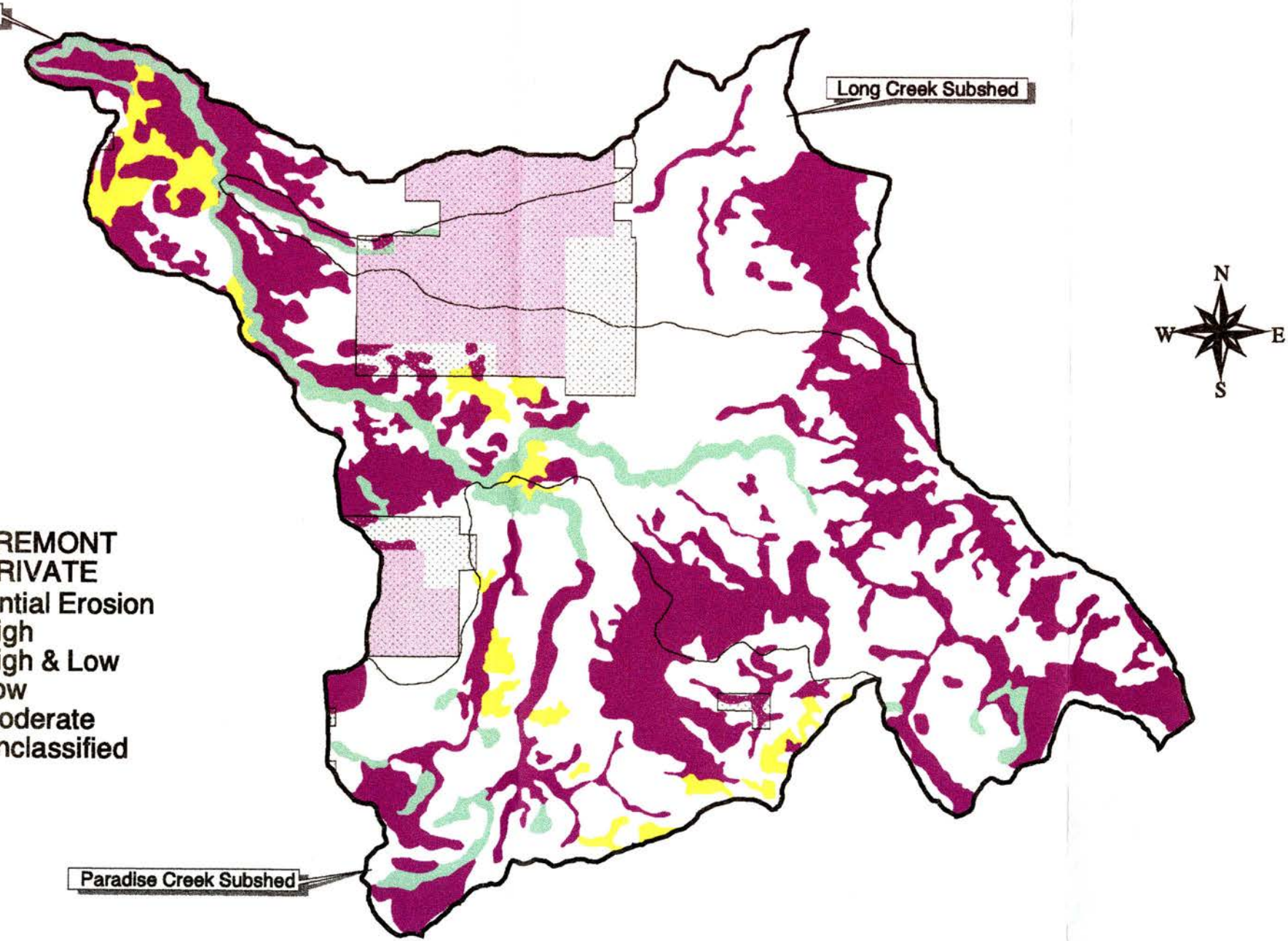
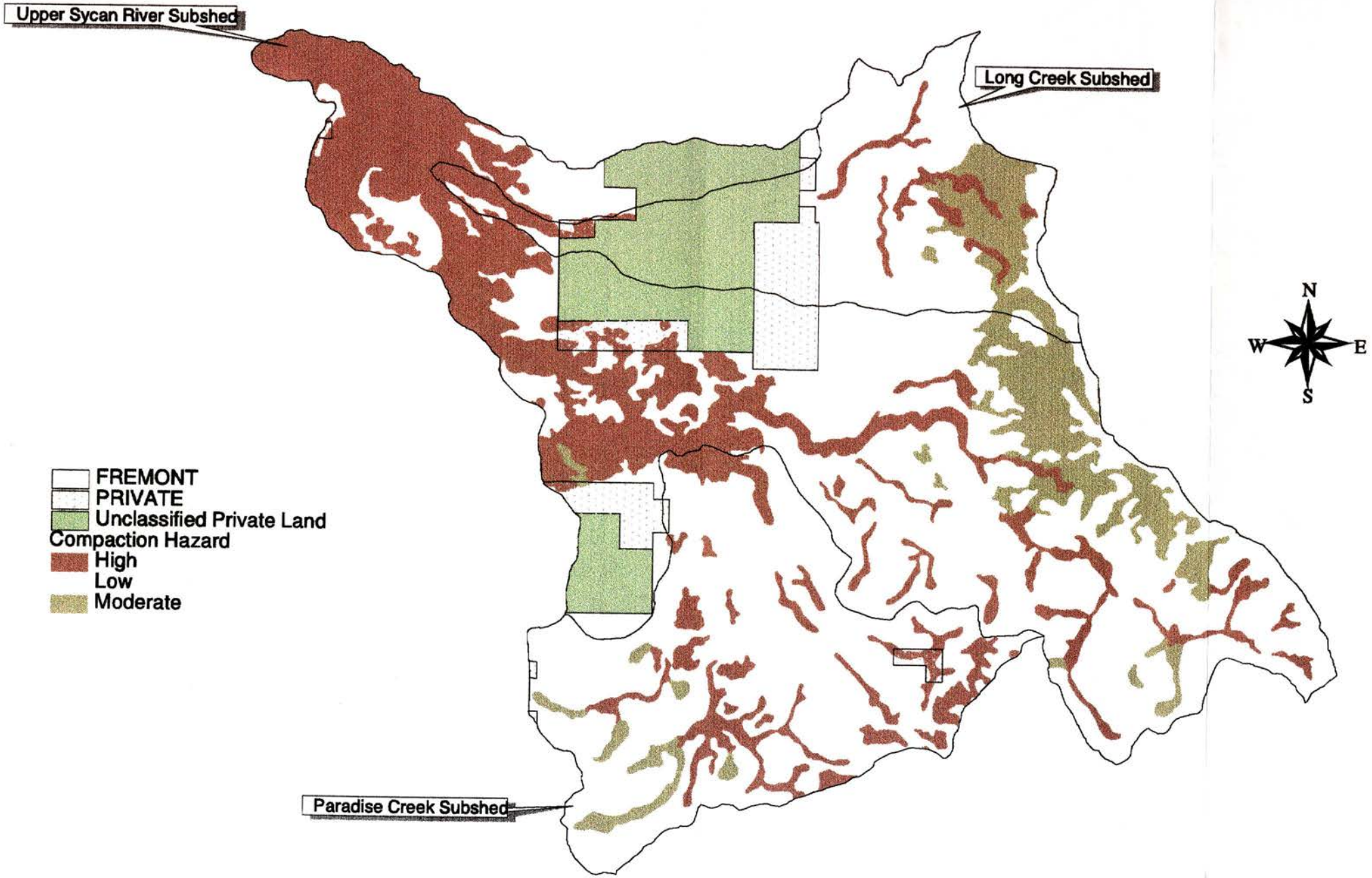
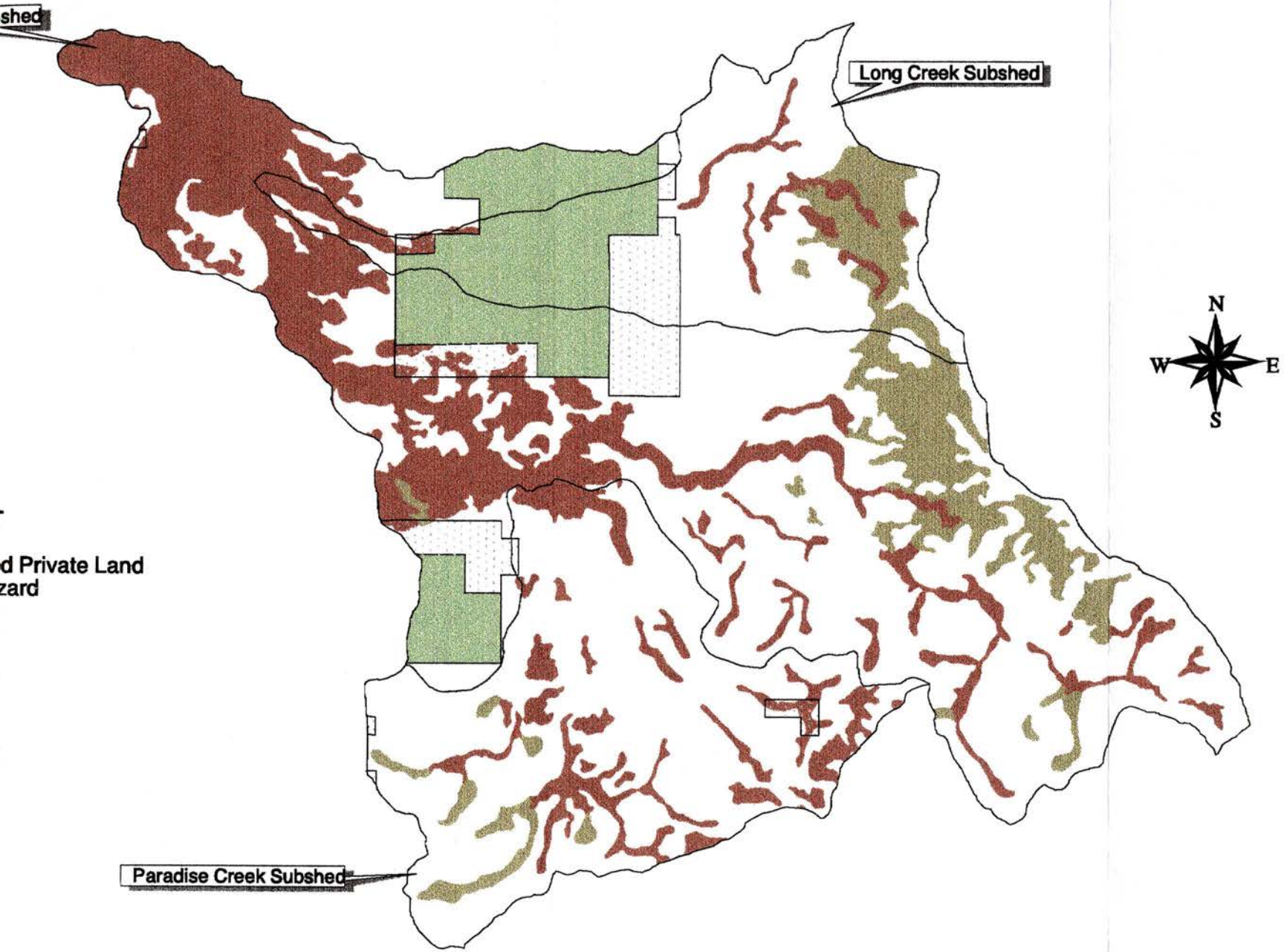


Fig. 1.3 Compaction Hazard In The Upper Sycan Watershed



Upper Sycan Watershed



The second group of soils is derived from basalt, andesite, and tuff parent materials, which are found on lava tablelands, volcanic eruptive centers, and block faults such as Winter Ridge. These soils are highly susceptible to compaction from management activities, which reduce infiltration and increase overland flow and erosion. They are a dominant soil and rock type in the Long and Upper Sycan River subwatersheds.

The third group of soils is derived from rhyolite and consists of those formed in wind-carried Mazama ash and pumice deposits. They are primarily found in the western or upper portion of the watershed encompassing the headwaters of the Sycan River. These areas have an ash or pumice layer over the buried rhyolite derived soils. Erosion risks from management activities vary from low to high, but gully erosion and displacement risks are moderate to severe depending on slopes.

The fourth group of soils also consists of those formed in wind-carried Mazama ash and pumice deposits and is the dominant soil and rock type in the watershed (most occur at the middle- to higher elevations of the watershed). These areas have an ash or pumice layer over the buried basalt/andesite derived soils. Erosion risks from management activities are low, but gully erosion and displacement risks are moderate to severe depending on slopes.

Both soil groups 3 and 4 are very poor conductors of heat. As a result, depending on the ambient air temperature, they become very hot or very cold quickly. This property has a significant influence on the type of plant associations which occur on these soils.

Overall, the primary sources of sediment within the watershed are associated with roads, past logging activities and stream bank erosion. Roads are a primary concern as they are the link between sediment source areas and stream channels.

Riparian Vegetation and Stream Channels

1. Riparian Vegetation

Water which escapes interception and use from trees, shrubs, and grasses becomes subsurface flow, eventually making its way through the soil to the narrow strips of land, called riparian areas, along creeks and rivers or other bodies of water. Riparian areas occupy a small percentage (about 5%) of the watershed, but they are an extremely important component of the landscape, especially in arid eastern Oregon (Elmore and Beschta 1987). Riparian vegetation buffers the fluvial system from potential impacts and disturbances caused by land management activities and natural events. Because of their close proximity to water, plant species within riparian zones differ significantly from those of adjacent uplands. Included within the analysis area are a variety of sedges, shrubs such as thinleaf alder and willow and deciduous trees such as and black cottonwood (note: see Appendix B for a complete list of scientific names for the species referred to in this document, cross-referenced and arranged first alphabetically by common name, then alphabetically by scientific name). These riparian plants play a significant role in retaining water received from the uplands. The stems of these plants provide roughness and resistance to dissipate floodwater energy and act as a filter to trap sediment transported by the stream (the sediment that is captured provides microsites for the germination and establishment of new plants within riparian areas). The strong root systems of these plants also provide resistance to a stream's erosive power, holding the soil mantle together, which minimizes stream bank erosion into the channel. By stabilizing stream banks and collecting sediment, riparian plant species act to maintain the integrity of riparian areas and elevate or maintain water tables. The increased subsurface flow, resulting from water storage in the riparian area, may be greater than the amount of water used by willow, cottonwood, alder, sedge, and rush (Elmore and Beschta 1987). In addition, low-gradient areas with willow attract beaver, resulting in ponds that expand riparian zones, further ensuring stream flow during summer months (Olson and Hubert 1994). Conifer species such as ponderosa pine, white fir, and lodgepole pine also occur along the edges of the riparian areas and within active floodplains.

The major influencing factors affecting riparian conditions within the analysis area are associated with grazing, fire suppression, and timber harvesting activities. Historical improper livestock grazing and beaver trapping has resulted in changes in the hydrologic functioning of streams and riparian areas. Beaver dams, which maintain floodplains, dissipate stream energy, and deposit sediment, were not maintained and eventually failed. This caused stream energy to be confined to discrete channels, leading to channel erosion and downcutting. In addition, livestock were allowed to graze season long and with concentrated use in riparian areas. Improper livestock grazing, in itself, can change species composition and reduce or eliminate riparian vegetation and can degrade riparian areas through channel widening, channel aggrading, or lowering of the water table (Platts 1991). In 1915, Reginald Bradley, the Fremont National Forest Deputy Supervisor, described intense

grazing which had downcut a once productive meadow in Lake County, Oregon:

> "Before this area was grazed, the whole of the flat, approximately 200 acres, was a fine meadow with a small stream running on to it and spreading out, naturally irrigating the grass, no pronounced channel being anywhere in evidence. Then came grazing by cattle and horses--principally cattle. Soon it was heavily overstocked and erosion commenced." (Bradley, 1915).

Although historical livestock grazing has resulted in riparian and stream channel degradation, current livestock numbers are considerably lower and most stream channels are steadily improving under present management.

In addition, fire suppression has affected the vegetative component of riparian areas by allowing encroachment of shade tolerant conifers into meadow, aspen, and willow communities. This, combined with livestock use, has reduced the ability of these deciduous communities to compete for site resources and to regenerate in the low light conditions caused by conifer encroachment. There has also been extensive timber harvesting and associated activities within the assessment area, although harvesting along riparian areas has had limited effect on the amount of shading and the number and type of large woody material in streams. All of these activities together have cumulatively influenced riparian areas within the watershed.

2. Stream Channels

The subsurface and overland flows make their way to the riparian area, filling stream channels like Paradise and Skull Creeks. The drainage network in the watershed consists of approximately 170 miles of stream channels, all forming an intricate network that eventually culminates in the Sycan River. These channels can be classified into four basic stream types (Rosgen A, B, C and E) that vary in their size, shape, pattern and position in the landscape (see Rosgen stream type discussion in the Step 4 – Reference Conditions) and are distributed amongst the three subwatersheds as follows: Upper Sycan River, 102 miles; Paradise Creek, 44 miles; and Long Creek, 24 miles. Approximately 73 miles of these streams are perennial, thus flowing continuously throughout the year. Intermittent stream channels, ones that flow immediately after a storm event and replenish water tables or seeps, account for 66 miles. Finally, ephemeral channels are similar to intermittent types; however, the streambed dries up rapidly due to porous soils and a disconnection to saturated water tables (Black 1996). They account for the remaining 31 miles.

Since 1993 (water years 1993-1998), flow measurements have been recorded at the mouth of Paradise Creek and on the Sycan River near the base of the watershed. The highest mean flow is 103 and 305 cubic feet per second (cfs), respectively, and occurs in May, produced by a mixture of rain and snowmelt within the watershed. The mean monthly flow for September, a low-flow month, is 2 and 8 cfs, respectively. Streams originating on the south and western side of the assessment area (Paradise Creek and Sycan River) have higher low-flows than those originating on the northern (Long Creek subwatershed) portion.

The level of stability in stream channels and riparian areas is defined by the balance between sediment deposition along banks (aggradation) and erosion/downcutting (degradation). Level of stability influences the integrity of riparian zones in the event of a major disturbance (DeBano et al. 1998). Under present conditions, intense upland erosion resulting from a catastrophic fire would be the most likely disturbance event in the Upper Sycan Watershed. A healthy riparian area will buffer against disturbance, capturing sediments that may inundate streams. But even the most productive riparian areas have limitations and cannot withstand severe forms of disturbance.

Habitat for Aquatic Species

The watershed provides water that supports many beneficial uses, including: irrigation, livestock and wildlife watering, road watering for dust abatement, wildlife habitat, hunting, fishing, water contact recreation, aesthetic quality, salmonid fish spawning and rearing, and resident fish and aquatic life. Of those listed, the primary uses include irrigation and those associated with habitat for aquatic species. The Sycan River, Paradise Creek, Crazy Creek, Watson Creek, Skull Creek, Rifle Creek, South Fork Sycan River, Boulder Creek, and the lower portion of Long Creek are the primary perennial fish-bearing streams with native redband trout, Miller Lake Lamprey, Pit-Klamath Brook Lamprey, and stocked brook trout present. Brook trout were introduced into the system in the 1930's, and are now widespread. Bull trout were last captured in the Sycan River in 1969, with visual sightings documented as late as the early 1980's; a hybrid bull trout was identified in 1994,

but since then neither a bull trout or hybrid has been found.

For the most part, these streams are providing adequate habitat for aquatic species--the exceptions being those reaches with high stream temperatures and/or livestock impacts that are causing stream channel/riparian areas or habitat variables to be less than desirable. The majority of reaches surveyed have ample numbers of large woody debris and pools, which are both important habitat features needed for viable populations of fish. Sediments exceeding the recommended threshold of fines in spawning gravels were only found in a few locations indicating the watershed is providing adequate spawning habitat for reproductive success. Stream temperatures, however, were found to exceed state standards at numerous locations, mainly Paradise Creek and the Sycan River (these two streams are both listed, due to high stream temperatures, on the State's "303d" list of water quality limited streams). Because stream temperature affects fish habitat, and is an important factor regulating aquatic life within these streams, it is considered to be a limiting factor that may be affecting fish populations. Increased width-to-depth ratios (larger surface area being heated) in stream channels are considered to be the primary cause of elevated temperatures, the extent of which is unknown. It is important to note that it is unknown if State stream temperature standards can be achieved *even under natural or desired* riparian and stream channel conditions. Fish passage concerns are widespread throughout the watershed, and need to be immediately addressed to ensure habitat connectivity and genetic exchange. Overall, temperature, low flows, fish passage and sediment appear to be the dominant limiting factors for aquatic species.

II. Vegetation

The vegetation of the watershed can be classified into three broad groupings: forested uplands, non-forested uplands and riparian. Riparian vegetation was discussed beginning on page (1-2).

Forested Uplands

There are about 65,700 acres within the Upper Sycan Watershed. National Forests lands comprise approximately 56, 400 acres. About 77% of Fremont National Forest lands within the watershed, or 43,600 acres, are forested. Three community types are represented: ponderosa pine, mixed conifer (also referred to as "ponderosa pine associated"), and lodgepole pine.

Ponderosa pine stands occur across approximately 17,500 acres of National Forest within the watershed. Ponderosa pine plant communities exist and thrive at the drier, warmer end of the climatic spectrum of forest types. These conditions exist at lower elevations as well as southern and western exposures (high-energy sites). Ponderosa pine stands will grade into mixed conifer and then lodgepole pine with increased elevation.

Mixed conifer stands occur across approximately 6,000 acres of National Forest lands within the watershed. Relative to the ponderosa pine types, these stand types exist at higher elevations and northern exposures (low energy sites). Always, ponderosa pine plays the seral role while white fir is the climax species. Within these plant communities, ponderosa pine and white fir will dominate with highly variable cover percentages that range from 5 to 75%. Lodgepole pine can also become a component in the stand but is not usually in a dominant or codominant position, though it will be an early pioneer following disturbance.

Lodgepole pine stands occur across approximately 20,050 acres of National Forest within the watershed. As a species, Lodgepole pine is the most adaptive coniferous species on the Fremont. The lodgepole pine on the Fremont NF is of the subspecies *murrayana* (Sierran lodgepole). This subspecies does not have serotinous cones but is a prolific seed producer. This species is the most cold hardy of all the conifers on the Fremont. These stand types occur at the highest elevations within the watershed. Lodgepole pine is also found along edges of ponderosa pine and mixed conifer stands where the stands reach down into low laying areas where cold air becomes restricted (frost pockets) or in any concave topographic feature where cold air may become trapped. Between disturbances, lodgepole pine will frequently encroach into areas such as aspen and grass meadows. These areas tend to be too cold or wet for other conifers to grow well.

1. Insects and Disease

Insects and disease are one of the major disturbance factors, which are important in the development of upland forests. The following table displays the most important insects and diseases that affect the three primary forest types found in the Upper Sycan Watershed. More detailed information on insects and disease, including current distribution and/or risk, is presented in Step 3 – Current Condition; pages (3-16) through (3-21).

Table 1.1. Important Insects and Disease

Forest Type	Insects	Disease
Ponderosa Pine	Western pine beetle, mountain pine beetle, turpentine beetle, pine engraver	*Annosus* and *armillaria* root disease, dwarf mistletoe
Mixed Conifer	Those listed above for ponderosa pine, plus fir engraver beetle, Modoc budworm, Douglas-fir tussock moth	Those listed above for ponderosa pine, plus Indian paint fungus
Lodgepole Pine	Mountain pine beetle	Dwarf mistletoe, pine needle cast, western gall rust

Non-Forested Uplands

Non-forested uplands within the watershed are characterized by meadow, shrub/bunchgrass communities and scattered juniper/low sage "scab-rock flats". Approximately 23% of the National Forest land within the watershed is non-forested. In addition, several open forested associations, with a ponderosa pine overstory and characteristic shrub/grass understory, contribute to the forage base.

The following seven vegetation communities comprise the non-forested vegetation within the Sycan Watershed:

Bluegrass-Dry Meadow (MD-31-11) association
Hairgrass-Sedge-Moist Meadow (MM-19-11) association
Sedge-Wet Meadow (MW-19-11) association
Big sagebrush/bunchgrass (SD-29-12)
Low sagebrush/bluegrass-onespike oatgrass ((SD-92-12) association
Low sagebrush/fescue-squirreltail (SD-19-13) association
Juniper/low sagebrush/fescue association

Descriptions of these communities were drawn from the 1979 handbook, Plant Associations of the Fremont National Forest by William E. Hopkins.

1. Meadow Communities

Three distinct plant associations represent the meadow communities in the Upper Sycan watershed. These communities represent the most productive forage producing lands within the watershed. Fire suppression has allowed conifers to encroach on meadows, resulting in decreased productivity and inhibited nutrient cycling. Historic improper livestock grazing practices has lead to downcut stream channels and lowered water tables at some sites.

The riparian "stringers" or greenline generally found in conjunction with these meadows are not defined separately from the meadow ecoclass associations in this analysis. Riparian vegetation is associated with streams that may or may not intersect these meadows and isolated riparian sites associated with springs and seeps are found within both forested and non-forested plant associations. A detailed description of characteristic riparian plant associations found on the Fremont National Forest is a work in progress under the USFS Area 4 Ecology Program and as a result, a summary of this classification was not available at the time of this analysis.

Dry meadow sites are represented by the **Bluegrass-Dry Meadow (MD-31-11)** association. The dominant species in this association are Kentucky bluegrass, Baltic rush and smallwing sedge, western yarrow and longstem clover. Sites with lowered water tables due to streambed downcutting may be dominated by silver sagebrush. Dry meadow sites have a water table at or near the surface in early summer and the entire soil profile is dry by early fall. These meadows can be sensitive to impacts with early season grazing due to saturated soils (Hopkins 1979).

The **Hairgrass-Sedge-Moist Meadow (MM-19-11)** association is comprised of tufted hairgrass and various combinations of sedges such as Nebraska sedge and smallwing sedge. Baltic rush and pullup muhly are subordinate species found in this association. Small percentages (1% or less) of silver sage may inhabit these sites and are prevalent on sites that have unnaturally lowered water tables. Moist meadow sites typically have a water table within 20-30 inches throughout most of the growing season and the rooting zone is almost always saturated. A wet site is indicated by trace amounts of forbs such as American bisort and monkeyflower. Trace amounts of Kentucky bluegrass, meadow barley and cinquefoils represent a fluctuation to a drier site. Kentucky bluegrass can become a weak dominant to tufted hairgrass due to overgrazing, but will not completely outcompete tufted hairgrass.

The **Sedge-Wet Meadow (MW-19-11)** association is comprised of wetland sedges such as Nebraska sedge, smallwing sedge, water sedge, bigleaf sedge and beaked sedge. Also present is Baltic rush and pullup muhly in small amounts. Tufted hairgrass will be present in trace amounts only. These sites are characterized by coarse sedge "mats" and have water at or near the surface year round.

2. Shrub/bunchgrass Communities

Several plant associations in the watershed are represented by sagebrush as the major shrub species. A majority of the sagebrush-dominated communities are in mid to late seral ecological status, primarily due to the suppression of fire on these rangelands.

Big sagebrush/bunchgrass (SD-29-12) sites are dominated by a big sagebrush shrub cover and bunchgrass herbaceous understory. Representative bunchgrasses include Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, and bottlebrush squirreltail. Although only lightly browsed by cattle, big sagebrush is represented as a climax shrub with significance for wildlife browse and cover. Big sagebrush communities are supported by a variety of soils, but are typically found on deep, well-drained, alluvial clay loams. Mesic north aspect sites tend to support more Idaho fescue with bluebunch wheatgrass found on southerly exposures associated with well-drained soils. Big sagebrush associations are particularly susceptible to juniper invasion with continued fire suppression or overuse by livestock (Hopkins 1979).

The **Low sagebrush/fescue-squirreltail (SD-19-13)** association supports low sagebrush, Idaho fescue, bluebunch wheatgrass, western needlegrass, Sandberg bluegrass, and bottlebrush squirreltail. Mesic sites will support one-spike oatgrass and prairie junegrass. Low sagebrush plant associations are supported by shallow, heavy clay soils that may be saturated in parts of winter and early spring (Hopkins 1979). Soils associated with this community are shallow, rocky and underlain by fractured bedrock at depths of 6-20 inches. Typically found in the northeastern portion of the watershed, this association has a high amount of surface rock or exposed fractured bedrock, hence the name "scab-rock flats". Low sagebrush-goldenweed-bluegrass (SD-92-11) is barely represented in the watershed.

The **Low sagebrush/bluegrass-onespike oatgrass (SD-92-12)** association is found scattered in more mesic pockets within the low sagebrush/fescue-squirreltail type. The soils are saturated in the spring, however, a shallow restrictive layer causes the soil profile to dry to an extreme in the summer and fall. Surface rock is prevalent.

3. Juniper Communities

Western juniper can be found in scattered pockets of the northeast portion of the Sycan watershed. Low sagebrush, curl-leaf mountain, and Idaho fescue make up the greatest composition on these **Juniper/low sagebrush/fescue (CJ-S1-12)** sites. Additional bunchgrasses such as bluebunch wheatgrass, western needlegrass, Sandberg bluegrass and squirreltail make up the additional herbaceous cover.

4. Open forest communities

Lodgepole pine type is the dominant forest plant community in the Sycan Watershed. This pine type is found associated with understory shrub and bunchgrass communities that make up an important portion of the land suitable for grazing in this watershed. These open timberlands were historically maintained by fires, which reduced seedling density and favored an open, herbaceous understory.

The inclusive **Ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue (CP-C2-11)** and the **Ponderosa pine/bitterbrush/fescue (CP-S2-11)** plant associations occupy high productivity sites in the Sycan watershed. Ponderosa pine, mountain mahogany and western juniper make up the overstory vegetation type. The shrub-layer consists of basin big sagebrush and bitterbrush with some gray rabbitbrush. Herbaceous cover is Idaho fescue and squirreltail.

The **Ponderosa pine-Quaking aspen/bluegrass (CP-H3-11)** community type consists of a dominant overstory of Ponderosa pine with quaking aspen as intermediate. Juniper, lodgepole pine and white fir can also be found in the understory. A dominant shrub layer is lacking, although mountain big sagebrush, serviceberry, creeping snowberry Oregon grape and wax currant are sometimes present. Wheeler's bluegrass, long stolon sedge, squirreltail, Idaho fescue, yarrow and strawberry are common in the herbaceous layer. This plant association is found adjacent to streambanks where the soil surface is wet in spring and early summer and the water table is at or near the surface year round which makes the soil subject to compaction in this type (Hopkins 1979).

Ponderosa pine/mountain big sagebrush/bluegrass (CP-S1-21) association has a Ponderosa pine overstory with an understory dominated by mountain big sagebrush. Understory herbaceous species are long-stolon sedge, Idaho fescue, strawberry and white hawkweed. Western juniper can also be an understory component, but was probably only a minor component. Rabbitbrush, long-stolon sedge and squirreltail increase with site disturbance. This association is typically found in the eastern portion of the watershed adjacent to Winter Rim.

Fire

Fire was historically the major disturbance in the Upper Sycan watershed and all the major vegetation types in this watershed evolved with recurring fire. Other natural disturbance patterns, such as insects, disease, and windfall, are often related to fire. Forest Service fire exclusion policies were largely effective starting after 1910. However, heavy sheep and cattle grazing in the 1800s and early 1900s may have reduced fire occurrence even prior to implementing fire exclusion policies.

Ponderosa pine forests cover 17,500 acres of National Forest lands in the Upper Sycan watershed; this comprises approximately 31 percent of the National Forest lands in the watershed. Broad changes in stand structure and large-scale species conversions can be attributed to fire exclusion, historical grazing practices and timber harvest. Fire history studies in Oregon's ponderosa pine forests indicate a fire return interval of 3 to 50 years, depending on the site conditions and weather patterns (Agee 1993).

Lodgepole pine covers approximately 20,000 acres of National Forest lands in the Upper Sycan watershed; this comprises approximately 36 percent of the National Forest lands in the watershed. These stands are generally found above 5,500 feet elevation. Fire studies completed on the Fremont show a fire return interval of 60 to 350 years (Stuart 1984). Studies in south-central Oregon show a history of major disturbance, by fire or insects, at least every 100 years in lodgepole forests (Agee 1981, Stuart 1983). Since the fire return interval in lodgepole pine forests is relatively long compared to the other forest types within the Upper Sycan watershed, fire exclusion has probably had the least effect in this type. However, the watershed has not experienced large-scale disturbance in at least the past 80 years. Fire behavior and intensity in lodgepole, as in other plant associations, is driven by fuel loading and continuity which are largely determined by the spatial scale and other dynamics of the insect disturbance

Mixed-conifer forests within the watershed comprise mainly ponderosa pine/white fir or lodgepole pine/white fir. Approximately 6,000 acres of National Forest lands, or 11% National Forest lands within the watershed, is classified as mixed-conifer. Although white fir has heavily invaded ponderosa pine forests, there are some areas within the watershed where evidence of large, old white fir indicates that those are the climax species. Some of the forests classified as mixed-

conifer today, may actually have been historically ponderosa pine forests. Absence of large-diameter white fir may indicate that the stand is not a true mixed conifer. Historical fire return intervals within true mixed-conifer forests are probably between 25 and 75 years. Where white fir occurs with ponderosa pine, fire-return intervals are probably at short end of the range. In the lodgepole pine/white fir associations, the fire-return interval is probably on the longer end of the range.

Aspen is a small, but significant forest type within the watershed. Aspen stands are found within all the forest types in the watershed and their fire return interval is probably related to the surrounding stands fire return intervals. Aspen may often act as a barrier to fire spread since it typically grows in more moist conditions.

Approximately 2600 acres, or 4% of the watershed, is comprised of scab-rock flats and another 3,300 acres or 5% are juniper forests. These areas are dominated by sagebrush, grasses and juniper and are generally found below 5,600 feet elevation. Fire exclusion has allowed juniper establishment in many of these scab-rock flats and may also be contributing to shrub dominance at the expense of herbaceous plants. Studies indicate historic fire return intervals in juniper to be between 10 and 25 years, but may be considerably longer on isolated patches of juniper. Fire histories are extremely difficult to determine in sagebrush, but historical fire return intervals were probably between 10 and 50 years, depending on the site productivity. Grazing practices may have also significantly affected the ecology of these scab-rock flats.

Noxious Weeds

The following noxious weeds have been identified within the Upper Sycan Watershed: Canada thistle, musk thistle and spotted knapweed. The negative effects that noxious weed infestations can have on croplands, forage for domestic livestock and wildlife, native biological diversity, and overall ecosystem health is well documented. The rising economic and environmental expense attributed to noxious weed management and the potential for spread off of National Forest land has increased public awareness and concern.

Threatened, Endangered, or Sensitive Plant Species

Green-tinged paintbrush and Blue-leaved penstemon, both listed on the R-6 Sensitive Species List, have documented occupied habitat occurring within the Upper Sycan Watershed. There are no populations of these R6 sensitive plants in Upper Sycan Watershed designated as protected under the Conservation Strategies in effect for these species.

III. Terrestrial Species and Habitats

Threatened, Endangered, and Sensitive Species

1. Northern Bald Eagle (Threatened, Proposed for De-listing)

Northern bald eagle activity has been documented in the Upper Sycan Watershed. One sighting, probably associated with foraging activities along the Sycan River, has been documented. There are no known active nest or roost sites identified within the watershed. The nearest known active nest site is located approximately 4 miles west of the northwest corner of the watershed.

2. American Peregrine Falcon (R-6 Regional Forester's Sensitive Species List; recently De-listed from Endangered)

Three peregrine falcon observations have been documented within the watershed near Government Harvey pass. One cliff site on the Sycan River has been identified as potential habitat. An additional 5 sites have been identified on or immediately adjacent to the watershed boundaries below Winter Ridge. It is not known if any of these sites are occupied. There are no known active or historical nest sites. Foraging habitat exists primarily along the Sycan River, at Sycan Marsh to the northwest, and in the Summer Lake basin east of the watershed.

3. California Bighorn Sheep (R-6 Regional Forester's Sensitive Species List)

No sightings of bighorn sheep have been documented within the watershed. Bighorn sheep occupy open habitats such as grasslands and shrub-grasslands. Forest zones are usually avoided. Adequate amounts of water and escape terrain such as broken rims, rock outcroppings, and cliffs must be present. Suitable habitat for bighorn sheep exists along sections of the Sycan River and to the east of the watershed below Winter Ridge.

4. Greater Sandhill Crane (R-6 Regional Forester's Sensitive Species List)

Sandhill crane sightings have been documented in the watershed near Sycan Marsh and in wet meadows associated with Crazy, Paradise and Watson Creeks and the Sycan River. Nest sites have been documented at Watson Creek, Louse Lake, and the Sycan River. Suitable habitat, moist and dry meadows associated with riparian areas and seasonally moist drainages, is present throughout the watershed.

5. Western Sage Grouse

No documented sightings occur within the watershed. There are no known currently occupied areas. Suitable habitat for sage grouse is found where relatively large areas of big sagebrush occur. Although areas of big sagebrush and low sagebrush occur within the watershed, primarily within the Upper Sycan subshed, their suitability as sage grouse habitat is questionable.

Keystone and Other Terrestrial Species

1. Big Game

The Oregon Department of Fish and Wildlife (ODF&W) designates Management Units for big game. The Upper Sycan watershed includes portions of both the Interstate and the Silver Lake Management Units. These areas are managed for mule deer, Rocky Mountain elk, and pronghorn antelope. The area also contains populations of cougar and black bear. All hunting is by permit or by quota system, with the exception of the general eastern Oregon black bear season and the first season Rocky Mountain elk general hunt.

The watershed primarily includes summer range for the Interstate and Silver Lake mule deer herds. It includes both winter and summer range for the North Interstate and Winter Ridge elk herds. A small portion (240 acres) along Winter Ridge includes spring transition range for the Silver Lake mule deer herd. In general, mule deer population appears to be on a slight upward trend. Elk numbers are increasing at a steady rate and may be approaching ODF&W management objectives.

The Upper Sycan watershed provides fair habitat for mule deer and other large ungulate species. Cover, both hiding and thermal, though plentiful, is generally poorly distributed throughout the watershed. Somewhat over 8,000 acres of the watershed are classified as non-forested and may not be able to produce significant amounts of cover. Cover utilized in these areas may not meet current Fremont Land Resource Management Plan (LRMP) definitions, but may nevertheless function as big game cover. Forage is highly variable over the watershed. Concentrations of high quality forage, primarily grasses, forbs, and sedges associated with riparian areas, meadows and small openings are distributed throughout the watershed. Sagebrush, bitterbrush, and mountain mahogany occur at lower elevations and forest edges.

2. Beaver

Evidence of beaver activity is present in all three subsheds within the watershed, though no distinction between historic and current activity has been made. Historically, beaver colonies existed within all three subsheds, with the highest concentrations in the Upper Sycan River subshed.

3. Other terrestrial Species

Other terrestrial animals common to the high desert and east Cascades are found in the area. Bobcats, coyotes, rabbits, porcupines, red-tail hawks, golden eagles, prairie falcons, ravens, kestrels, great gray and great-horned owls, amphibians, reptiles, neotropical birds, primary and secondary cavity nesters, and numerous other raptors, birds, and small mammals are all present within the watershed.

Management Indicator Species Associated with Late and Old (LOS) Forest Cover

1. General

There are 3,460 acres of allocated old-growth forest stands (Management Areas 3 and 14) within the watershed. Another 2,680 acres of old growth forest cover have been identified. Old growth forest cover represents approximately 13% of the forested vegetation in ponderosa pine and mixed conifer stands within the watershed. Late seral forest cover has not been mapped in the Upper Sycan Watershed. Based on known changes in old growth forest cover, it is assumed that LOS forest cover has declined since mid-century, and species composition has changed in pure ponderosa pine to a more mixed conifer forest. Little of this LOS forest cover is single-storied stands. Old growth forest cover in lodgepole pine stands represents approximately 14% of lodgepole pine habitat. LOS forest cover in lodgepole pine stands has increased. In general, habitat for species associated with open, parklike single canopy LOS ponderosa pine stands has declined while lodgepole pine and multi-storied mixed conifer LOS habitats have increased.

2. Northern Goshawk

Twenty goshawk nests and eleven territories have been identified within the watershed. Suitable habitat for goshawks currently exists in all subsheds. However, habitat suitability and availability overall has declined with the decreases in LOS forest cover, conversion of LOS forest cover to multi-storied habitats, and increases in understory vegetation.

3. Pileated Woodpecker

There are no known active pileated woodpecker nest sites within the watershed. Pileated sightings and foraging activity have been documented within the area. Suitable habitat exists within mixed conifer LOS stands. Overall, habitat suitability has increased where conversion of LOS forest cover to multi-storied habitats has occurred.

4. American Marten

Potential marten habitat exists in all subsheds within the watershed. However, no occurrence of marten has been confirmed within the watershed. Both habitat availability and continuity have declined within the last 50 years. Habitat suitability however, may have increased in patches of LOS forest habitat.

5. Black-backed/Three-toed Woodpecker

Black-backed woodpecker sightings have been documented within the Long Creek subshed. Although black-backed woodpeckers are most commonly associated with LOS lodgepole pine habitats, suitable habitat exists within forest stands where insect activity has provided foraging opportunity. Availability, continuity, and suitability of habitat in ponderosa pine and mixed conifer habitats and continuity in lodgepole pine habitats have declined over the past 50 years, while availability and suitability have increased in lodgepole pine habitats with increases in LOS forest cover.

Dead Wood Habitat Management Indicator Species (MIS)

1. Primary Excavators

Snag and down log densities are variable across the watershed. Ponderosa pine stands and timber harvest units generally contain minimal amounts. Lodgepole pine and mixed conifer habitat generally have densities that exceed wildlife habitat needs. All subsheds have probably experienced a decline in primary excavator populations in the last 50 years, although localized shifts in distribution, relating to disturbance events such as fire or insect outbreak, have undoubtedly occurred. Habitat quantity and continuity has declined during this period while suitability has increased with large tree mortality in late and old forest cover and increases in LOS lodgepole pine habitats.

Aspen/Deciduous Riparian Habitat

1. Red-naped Sapsucker

The preferred habitat of sapsuckers is LOS aspen stands. Aspen is distributed throughout the watershed. When areas with scattered aspen occurrence are included, approximately 8,700 acres of aspen have been identified within the watershed, primarily located in the Long Creek and Upper Sycan subsheds. Aspen distribution is generally restricted to moist/wet sites associated with riparian areas or seasonally wet areas. Many aspen stands are decadent, with heavy conifer encroachment, and little regeneration.

IV. Human Uses

The Upper Sycan Watershed is a complex natural environment that has provided resources to both aboriginal and historic human beings. The majority of these resources were used for daily sustenance. However, this majestically forested area was also a vehicle for human spiritual renewal and mental stimulation and satisfaction. The area has likely been seasonally lived in and had resources extracted for approximately the last 10,000 years. Everything prehistoric people needed could be found in the watershed area. Euro-Americans that moved in at the end of the 19th century found the lumber they needed and forage for their grazing livestock.

At the time of contact with western settlers, the Upper Sycan River area was utilized and occupied by the Klamath Tribes as well as the Yahooskin Paiute. Because of the high elevation of the area and isolation from major village sites, this area was used during a very short season when access and resources were available.

Euro-American resource extraction and settlement activities focused around the area at the headwaters of the Sycan River. Aspen tree arborglyphs found in this area date from the early 1900's up to the current time. These tree carvings are associated almost entirely with sheep herding activities.

The Hanan Trail was the earliest connection for early Euro-American settlers between the head of the Sycan River and surrounding areas such as Coffeepot Flat and the Currier Trail. The high presence of lithic material near the trail indicates that it's use likely preceded the settlement period, and may have extended well back into the pre-historic period, possibly as a trade route connecting the Great Basin with the Pacific drainages. At one time the trail was much longer than it's current 8 miles, as roads have replaced it - especially the main Forest Road 28. The Trail is apparently named for John Hanan, a very early settler in the Summer Lake Valley.

Pike's Crossing on the Sycan River is named for George Pike, an early settler. The origin of the name for Emigrant Crossing is unclear. Emigrant Crossing appears to have been little used, as it was generally too steep for wagons.

An historic travel route, the Yreka Road, crosses the area. This road originated in Yreka, California and travels in a general northerly and easterly direction. The terminus for this early road was in the mining country in and around Canyon City, Oregon.

Historically, the area was used for livestock grazing and as an area for extracting saw logs. Most of the road construction was begun after World War II (1945) when timber harvesting accelerated.

Recreational use activities within this watershed include fishing, swimming, camping, picnicking, sightseeing, hunting, wildlife observation and winter activities such as snowmobilng and cross-country skiing. The Sycan River and its tributaries provide opportunities for recreation in river-type environments in this otherwise drier ecosystem. In the upper reaches of the watershed the Hanan Roadless area with the Hanan Trail provides for a unique recreation experience.

STEP 2. IDENTIFICATION OF ISSUES AND KEY QUESTIONS

Step 2 identifies the issues and corresponding key questions developed by the analysis team. This identification of key questions helps focus the analysis on the elements of the ecosystem that are most relevant to the management objectives, human values, or resource conditions within the watershed.

I. Watershed and Aquatics

A variety of issues related to watershed processes arose during the analysis. These include issues and concerns relating to:

- The quantity of water used by increasing numbers of juniper and other overstocked conifer stands crowding the landscape. This water could be available for forage production and maintenance of stream flow.
- Conifer encroachment into meadows and aspen stands
- Roads and culverts and their effects on sediment delivery to streams and fish passage, respectively.
- Riparian and stream channel conditions and whether these conditions provide suitable habitat for aquatic species.
- The ability to manage for viable populations of native trout, which can be used to indicate whether or not land management activities are ecologically sound.

The broad question dealing with the discussion of these processes and issues is: how *can the watershed be managed to improve the capture, storage, and slow release of water, and improve fish habitat*? To answer this, four key questions were formulated which reflect the connection between uplands, riparian areas, stream channels, and native trout. These four questions will provide the basis of discussion and analysis of watershed and aquatic resources for the remainder of this document.

Key Questions:

1. Is the upland portion of the watershed producing hydrological conditions (water and sediment outputs) which contribute to properly functioning riparian areas?

2. Is vegetation in riparian areas contributing to the appropriate channel types and hydrologic regime?

3. Are the channels providing adequate fish habitat?

4. How are the above watershed conditions influencing native trout viability?

II. Vegetation

Past management activities and alteration of natural disturbance processes, including fire exclusion, have changed the function, pattern, composition, structure, and density of vegetation within the watershed. Noxious weed infestations have the potential to negatively impact natural biological diversity, ecosystem health with resultant degradation of forage for wildlife and domestic livestock, recreational values, croplands and soil productivity. The level of threat posed by various species of noxious weeds depends on factors such as the degree of detrimental effects they can produce, their reproductive and dispersal capabilities, difficulty of control, and overall distribution.

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?
Parameters: Past and present landscape matrix (pattern analysis) of plant species composition (TES species), size, age structure, and density.

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?
Parameters: Past and present distribution of condition class and seral stages, magnitude, intensity, and location of fires, in the past century, management actions in terms of logging, grazing, road construction, and fire suppression, incidence of insect and disease activity.

3. What rare or designated sensitive plants occur in the watershed?
Parameters: Habitat of protected or managed sensitive species.

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?
Parameters: Extent and location of noxious weeds. Agents of spread or transport of noxious weeds including, general public use, logging, grazing and road construction and maintenance.

III. Terrestrial Species and Habitats

Management practices such as logging, grazing, and road building have been shown to potentially alter wildlife habitat conditions.

Key Questions:

1. How have wildlife abundance, distribution, diversity and habitat conditions been altered?
Parameters: Past and present habitat potential, suitability, security, and conditions. Wildlife species composition, distribution and populations.

2. What key terrestrial habitat components are scarcest or most at risk? What threatens species viability?
Parameters: Core late/old seral forest habitat, cover/forage habitat, nesting/fawning/rearing habitat, security habitat, dead wood habitat, and wildlife species distribution and population. Also, location of habitat for threatened, endangered, and sensitive (TES), keystone, and management indicator species and habitat connectivity.

3. Where are the known problem areas that are contributing to reduced wildlife habitat capability?
Parameters: Location and timing of management activities and natural disturbance events affecting wildlife habitat abundance, condition, distribution, and diversity.

IV. Human Uses

Appropriate uses of resources can benefit watershed health while contributing to the viability of local communities. On the other hand, people's needs for uses, values, products, and services have the potential to exceed the limitations of maintaining ecosystem health, diversity, and productivity.

The Upper Sycan Watershed is within the "Area of Cultural Influence" of The Klamath Tribes (also referred to as "Area Impacting the Tribes' Treaty Rights") as defined by the February 15, 1999 Memorandum of Agreement between the Klamath Tribes and the U.S. Forest Service. The United States has a trust responsibility to protect the Klamath Tribes' Treaty Rights.

The initiation, development and implementation of management activities in the watershed have the potential to affect Treaty Right resources either positively or negatively.

Key Questions:

1. How should the watershed provide for future human uses and needs?
Parameters: Timber harvest opportunities and trends, livestock grazing, road access, recreation facilities and opportunities, and cultural plant and animal abundance and distribution.

2. How will roads be managed to meet present and future uses and protect all resource values?
Parameters: Public access, fire control, livestock grazing and logging systems needs, road closures and obliterations, accelerated erosion and stream sediment, fish and wildlife habitat suitability, and species productivity.

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?
Parameters: Logging and road systems, soil compaction and erosion, water quality, fish and wildlife habitat suitability and species productivity, and wood products availability.

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?
Parameters: Mule deer and other game traditionally hunted or trapped by Tribal members, downstream effects on fish and other aquatic species, cultural plants, cultural sites.

STEP 3. DESCRIPTION OF CURRENT CONDITIONS

The purpose of this step is to present detailed information that deals with the current range, distribution and condition of the relevant ecosystem elements within the watershed. These elements were initially discussed in a less detailed manner in Step 1 "Characterization". Current condition generally reflects information that has been gathered within the past 3 or 4 years. For many elements, information was gathered during the field seasons of 1998 and 1999.

I. Watershed and Aquatics

During the summers of 1998 and 1999, survey crews and resource professionals collected data across the watershed to obtain current condition information about various watershed elements so that an assessment could be performed that would address four key questions. This chapter simply describes those current conditions within each of the subwatersheds. Prior to the current condition descriptions is a brief description of methodology for each element.

Data collected for Key Question 1 was gathered across the entire watershed. Information for Key Questions 2 and 3 was gathered and summarized on a stream reach basis. In general a reach is a segment of stream of similar gradient, valley type, etc. For example, a segment of stream flowing through a gentle meadow valley would be a separate reach relative to a segment occurring in a steeper mountain area. Only the primary perennial streams within the watershed were surveyed (due to a lack of time and funding, Long Creek was not surveyed). Key Question 4 is a summary of the first three questions, but discussions addressing this question will not occur until Step 5--Synthesis and Interpretation

Uplands

Key Question 1: Is the upland portion of the subwatershed/watershed producing hydrologic conditions that contribute to properly functioning riparian areas?

1. Upland Plant Communities and their Effect on the Amount of Water and Sediment Reaching Riparian Areas

Methodology: Forested stands with high canopy closure were located using satellite imagery available on the Fremont National Forest's Geographical Information System (GIS)--due to data limitations, canopy closure from ISAT data is used instead of leaf area index to quantify recovery. This information is provided since an increase in conifer densities may result in a loss of water available for stream flow during the dry summer months. As shown in Step 4 (Reference Conditions), Fremont National Forest silviculturists described a range of presettlement canopy closures--or the Historic Range of Variability (HRV) for various forest types--under which the Upper Sycan River Watershed streams evolved. These include the following: ponderosa pine, 11-40%; mixed conifer (ponderosa pine and white fir), 26-55%; lodgepole pine and white fir, 41-70%. Forested stands are considered hydrologically recovered, in terms of their water use and yield, when canopy closure reaches these reference condition ranges. Early seral conditions, those forested lands in openings—mainly as seedling/sapling stands, were determined from condition class and harvest layers available in GIS. This information was compared with aerial photographs to verify accuracy.

Paradise Creek Subwatershed: Within the 16,000 acre subwatershed, forested lands cover 14,000 acres or approximately 89% of the subwatershed. Conifers have encroached into many of the dry and moist meadows and aspen stands, which account for 460, 400, and 250 acres, respectively. Scattered aspen (< 20% aspen) occupy about 40 additional acres throughout the subwatershed, while wet meadows account for approximately 109 acres. There are an estimated 210 acres of juniper/low sagebrush/fescue plant community, with encroachment of juniper occurring in the drier, deeper-soil pine sites.

Of the forested acres, 14%, or 1,900 acres, have been determined to have canopy closure that exceeds HRV. Refer to Figure

5.1 - Upper Sycan River Watershed Upland Vegetation following page (5-1). Approximately 25% of the forested lands are in openings, mainly as seedling/sapling sites. In addition, the effects of management activities on soil resources have been fairly extensive, a result of past timber harvest activities throughout the subwatershed. Theses effects are chiefly associated with increased compaction, which increases the likelihood of overland flow of water occurring.

Long Creek Subwatershed: Within the 11,300 acre subwatershed, forested lands cover 9,800 acres, approximately 87% of the area. Conifers have encroached into many of the dry and moist meadows and aspen groves, which account for 1,100, 130, and 215 acres, respectively. Scattered aspen (< 20% aspen) are found throughout the southeastern portion of the subwatershed, occupying about 3,840 acres. There are an estimated 200 acres of the juniper/low sagebrush/fescue plant community, with encroachment of juniper occurring in the drier, deeper-soil pine sites.

Eighteen percent, or 1,700 acres of the forested areas, have canopy closure that exceeds HRV. Refer to Figure 5.1 – Upper Sycan River Watershed Upland Vegetation. The private land, owned by US Timberlands Services, was harvested mostly in the 1970's and is comprised of ponderosa pine and lodgepole pine plantations having forest canopy closures within HRV. These forest sites are considered hydrologically recovered, in terms of their water use and yield, because the leaf area is sufficient to return transpiration rates to reference or historic conditions and canopy closure is sufficient to prevent rapid snowmelt. About 11% of the subwatershed consists of forest openings, mainly seedling/sapling sites. In addition, the effects of management activities on soil resources has been fairly extensive, a result of past timber harvest activities throughout the subwatershed.

Upper Sycan River Subwatershed: Within the 38,400 acre subwatershed, forested lands cover 30,600 acres or approximately 80% of the subwatershed. Conifers have encroached into many of the dry and moist meadows and aspen stands, accounting for 775, 770, and 775 acres, respectively. Scattered aspen (< 20% aspen) are found throughout the northwestern portion of the subwatershed occupying about 3,570 acres, while wet meadows account for approximately 190 acres. There are an estimated 1,990 acres of the juniper/low sagebrush/fescue plant community, with encroachment of juniper occurring in the drier, deeper-soil pine sites.

Of the forested acres, 10% or 3,300 acres have been determined to have canopy cover that exceeds HRV. Refer to Figure 5.1 – Upper Sycan River Watershed Upland Vegetation. The private land, owned by US Timberlands Services, was harvested mostly in the 1970's and is comprised of ponderosa pine and lodgepole pine plantations having forest canopy closures within HRV. These forest sites are considered hydrologically recovered, in terms of their water use and yield, because the leaf area is sufficient to return transpiration rates to reference or historic conditions and canopy closure is sufficient to prevent rapid snowmelt. Conversely, about 6% of the subwatershed consists of forest openings, which are mainly seedling/sapling sites. In addition, the effects of management activities on soil resources has been fairly extensive within the subwatershed, a result of past timber harvest activities.

2. Road Density, Location, and Drainage Network

Methodology: Current road locations, densities, and crossings were acquired from the Fremont National Forest GIS 1998 road layer. Road crossings were identified from GIS and checked for accuracy. Those crossings determined to be inaccurate were deleted. Roads account for most of the sediment problems in a watershed because they are a link between sediment source areas (skid trails, landings, and cutslopes, etc.) and stream channels. They directly affect the channel morphology of streams by accelerating erosion and sediment delivery and by increasing the magnitude of peak flows (Furniss et al. 1991). The following are general descriptions of the methods used to evaluate the effects of roads within the analysis area.

Wemple (1994) focused on the interaction of forested roads with stream networks and found that nearly 60% of the road network drained into streams and gullies, and are therefore, hydrologically integrated with the stream network. The 60% figure, from Wemple's study, will be used in this analysis to estimate the percent increase in drainage network efficiency for each subwatershed. Closed roads are considered to contribute to the overall drainage efficiency and are therefore included.

Rosgen (1991) has developed a Road Impact Index, which is a qualitative indicator of sediment delivery risk associated with road density and the number of stream crossings. This index will be used for this assessment (only on a subwatershed basis) and relies on the following formula: Road Impact Index = (acres of road within the subwatershed) /

(acres within the subwatershed) x (the number of stream crossings). This method is based on the following assumptions: 1) the higher the road density the higher the potential for sediment yield increases due to the larger acreage of exposed surfaces, 2) the more drainage ways that are crossed the higher probability that direct sediment introduction will occur, and 3) the higher on the slope that the road is from the drainage network, the less probability for delivered sediment to occur (erosion may occur but is less likely to be routed to the stream). Road Impact Index is used as a comparison tool to determine relative impact by roads between one subshed and another.

Paradise Creek Subwatershed: There are 77 miles of roads within this subwatershed, which results in a road density of 3.1 mi/mi². Refer to Figure 5.2 – Upper Sycan River Watershed Road Locations, following page (5-2). Of these roads, seven miles (9%) are within 300 feet of perennial and intermittent streams. Furthermore, roads cross channels at 33 locations, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.35. Along with the 44 miles of stream channels, an estimated 46 of the 77 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 105%--using Wemple's (1994) study results.

Long Creek Subwatershed: There are 55 miles of roads in the subwatershed, which results in a road density of 3.1 mi/mi². Refer to Figure 5.2 – Upper Sycan River Watershed Road Locations. Of these roads, seven miles (13%) are within 300 feet of perennial and intermittent streams. In addition, roads cross channels at 17 locations, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.18. Along with the 24 miles of stream channels, an estimated 33 of the 55 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 138%--using Wemple's (1994) study results.

Upper Sycan River Subwatershed: There are 164 miles of roads in the subwatershed, leading to a road density of 2.7 mi/mi². Refer to Figure 5.2 – Upper Sycan River Watershed Road Locations. Of these roads, twenty-one miles (13%) are within 300 feet of perennial and intermittent streams. At 69 locations throughout the subwatershed, roads cross channels, sites where direct sediment introduction occurs. Based on the above numbers, the Road Impact Index was calculated to be 0.64. Along with the 102 miles of stream channels, an estimated 98 of the 164 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 96%--using Wemple's (1994) study results.

Riparian Vegetation and Stream Channels

Key Question 2: Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

1. Riparian Vegetation and Associated Bank Stability

Methodology: During stream surveys conducted in 1998 and 1999, the dominant vegetation types within the riparian area were documented. In addition, the associated bank stability was described. Actively eroding banks, above the bankfull height, were counted as unstable.

Vegetative compositions and dominance along flood-prone areas of the Upper Sycan Watershed streams varies, depending on stream type. Along the alluvial, low-gradient C and E stream channel types, sedge, rush, and willow are commonly observed. Sedge species include aquatic sedge, Nebraska sedge, wooly sedge, beaked sedge, and inflated sedge, the latter two found in areas that are saturated and marshy throughout the summer. Additional wetland species that are commonly observed colonizing disturbed sites include creeping spikerush, and to a lesser degree few-flowered spikerush. Common rush species include the following: Baltic rush, sword-leaf or dagger-leaf rush, Nevada rush, and long-style rush. The Nevada and Baltic Rush are common, found in low gradient meadow systems, often below bankfull depth. The long-style rush has a wide range throughout the watershed, being found on most stream types, low gradient E channels and higher gradient B channels. The sword-leaf rush is less common and most often occurs within low gradient stream types (C and E).

Four willow species occur within the watershed: Geyer willow, whiplash willow, Booth's willow, and Scouler's willow. Geyer and whiplash willows occur throughout the watershed along most stream types, with Geyer being most common. Booth's willow is less common, but is often found in C stream reaches of the Sycan River. Finally, Scouler's Willow is usually found in moist upland areas.

Other deciduous shrub and tree species found along watershed streams include mountain alder, black cottonwood, quaking aspen, bog birch, and red osier dogwood. Mountain alder and black cottonwood are commonly along the B channel reaches of the Sycan River and other streams within the watershed. Quaking aspen is frequent along B channel types, a common subdominant along tributary streams. Bog birch is less common and can be found in wet areas along most stream types.

The summary tables that follow describe riparian and upland vegetation for all stream reaches surveyed within the watershed. For reach locations refer to Figure 5.3 – Upper Sycan Watershed Reach and Monitoring Locations, following page (5-3).

Paradise Creek Subwatershed: The Forest Service portions of three streams were surveyed within this subwatershed. Nearly 9 miles of Paradise Creek was divided into nine reaches; Crazy Creek was divided into seven reaches, which totaled nearly 7 miles in length; and Watson Creek was divided into six reaches that totaled just over 6 miles in length. The following tables (Tables 3.1, 3.2, and 3.3) are a summary of current condition information that was collected to describe the dominant vegetation types and the associated bank stability within riparian areas of Paradise, Crazy, and Watson Creeks.

Table 3.1. Paradise Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
					Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	0.7	USFS	10	1	SE	HW 1-2	GR	CL 1	CL 3	GR	91
2	2.1	USFS	14	2-4	SE	HW 2-4	CL 2-3	GR	CL 3	GR	95
3	2.0	USFS	13	1	SE	GR	CL 1	HW 1	CL 3	GR	93
4	0.6	USFS	13	1	SE	GR	HW 1-2	CL 1-2	CL 3	GR	98
5	0.8	USFS	6	1	SE	HW 1	GR	SS 1	SS 1	GR	93
6	0.4	USFS	4	<1	SE	GR	HW 1	SS 1	SS 1	GR	74
7	0.7	USFS	3	<2	SE	HW 1-2	GR	SS 1	SS 1	GR	77
8	1.2	USFS	4	4	SE	HW 1-2	GR	CL 2-3	CL 3	GR	91
9	0.5	USFS	4	8	SE	GR	HW 1-2	CL 2-3	CL 2-3	GR	96

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

Table 3.2. Crazy Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
					Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	1.7	USFS	6	3	SE	GR	HW 1-4	CL 1-3	CL 1-3	CP 1-3	99
2	1.4	USFS	5	1	SE	GR	CL 1-3	HW 1-3	CL 1-3	CP 1-3	96
3	0.8	USFS	5	1	SE	GR	HW 1-4	CL 1-3	CL 1-3	SS 1	97
4	0.6	USFS	4	1	SE	GR	HW 1-4	SS 1	CL 1-3	SS 1	99
5	0.9	USFS	4	1	SE	GR	HW 1-3	CL 1-3	CL 1-3	SS 1	98
6	0.9	USFS	3	1	SE	GR	HW 1-3	CL 1-3	CL 1-3	SS 1	98
7	0.3	USFS	3	2	SE	GR	HW 1-3	CL 1-3	CL 1-3	CW 1-2	99

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

Table 3.3. Watson Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
					Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	1.4	USFS/ Private	9	2	SE	HW 1-4	SS 1	GR	SS 1	GR	91
2	1.5	USFS	8	2	SE	GR	HW 1-3	CL 2-3	CL 2-3	GR	96
3	0.9	USFS	7	2	SE	GR	HW 1-3	CL 2-3	CL 2-3	GR	91
4	1.1	USFS	6	2	SE	GR	CL 1-2	HW 1-3	CL 2-3	GR	86
5	0.8	USFS	5	1	SE	GR	CL 1-3	HW 1-2	SS 1 / CL 2-3	GR	91
6	0.5	Private	5	1	SE	GR	HW 1	SS 1	SS 1	GR	97

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

Long Creek Subwatershed: Due to prioritization and time, no surveys occurred within this subwatershed. However, a general description of streams within this subwatershed will be give based on field reconnaissance associated with past projects in the area. The lower portion of Long Creek is perennial, while the remaining channels within the subwatershed are intermittent and transport water only during spring snowmelt and intense thunderstorm events. Bank instability within the subwatershed is localized, occurring mainly in the lower gradient, depositional reaches. Areas of instability are typically less than 15-20 inches in height and 10-30 feet long. Seasonal seeps and springs occur along the major drainages, with aspen present in varying conditions. Grasses, sedge, willow, aspen, and conifers are the dominant vegetation types within riparian areas, although false hellebore does dominate a few sites.

Upper Sycan River Subwatershed: 27 miles of the Sycan River, from its headwaters in the Hanan Trail Roadless Area to its entrance into the Sycan Marsh, was surveyed and divided into thirteen reaches. The other stream surveyed within this subwatershed is Skull Creek, which was divided into six reaches that totaled six miles in length. The following tables (Tables 3.4 and 3.5) are a summary of current condition information that was collected to describe the dominant vegetation types and the associated bank stability within riparian areas of the Sycan River and Skull Creek.

Table 3.4. Sycan River – Riparian Vegetation and Associated Bank Stability

Reach Information					Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
					Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	2.3	USFS	43	2	GR	SE	HW 1-2		CP 4	GR	90
2	1.6	USFS	42	2	SE	HW 1-2	GR	CP 2-4	CP 4	GR	99
3	1.3	USFS	33	3	SE	HW 1-2	GR	CP 2-4	CP 2-4	GR	98
4	4.3	USFS	38	3	SE	GR	HW 1-2	CP 2-4	CP 2-4	GR	97
5	1.9	USFS	30	3	SE	HW/HA/HD 1-3	GR	CL/CP 1-4	CL/CP 1-4	GR	100
6	0.8	USFS	30	2	SE	HW 1-3	GR	CL 1-4	CL 1-4	GR	99
7	1.9	USFS	24	1	SE	HW 1-3	GR	CL 1-4	CL 1-4	GR	100
8	1.5	USFS	22	3	SE	GR	HW 1-2	CL 1-4	CL 1-4	GR	98
9	2.4	USFS	22	2	SE	HW/HD 1-4	GR	CL 1-4	CL 1-4	GR	100
10	1.6	USFS	20	1	SE	HW 1-4	GR	CL 1-4	CL 1-4	GR	99
11	0.6	USFS	19	2	SE	HW 1-3	GR	CL 1-4	CL 1-4	GR	98
12	3.2	USFS	12	1	SE	HW 1-3	GR	SS 1	S 1	GR	94
13	4.0	USFS	4	2	SE	GR	HW 1-2	CL 1-4	CL 1-4	GR	98

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

Table 3.5. Skull Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
					Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	1.4	USFS	4	1	SE	GR	HW 1-2	CL 1-3	CL 1-3	SS 1	98
2	0.4	USFS	4	<1	SE	GR	HW/HB 1-2	CL 1-3	CL 1-3	CW 1-2	99
3	1.9	USFS	3	<1	SE	GR	SS 1	CL 1-3	CL 1-3	CP 1-3	96
4	1.1	USFS	3	<1	SE	GR	HW 1-3	CL 1-3	CL 1-3	CP 1-3	97
5	1.1	USFS	3	2-4	SE	GR	HW 1-3	HB 1-3	CL 1-3	CW 1-3	98
6	0.5	USFS	1-2	2-4	SE	GR	HW/HQ 1-3	CL 1-4	CL 1-4	CW 1-3	99

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

2. Rosgen Stream Types

Methodology: As part of the stream surveys that occurred within the watershed, field measurements outlined in Rosgen (1996) were conducted to determine stream type. These measurements included entrenchment, bankfull width-to-depth ratio, sinuosity, gradient, and dominant channel substrate. *Entrenchment* is the vertical containment of the stream channel and refers to the ability of a stream to access its floodplain. The stream is entrenched when floodwaters are confined to the channel and is not entrenched when floodwaters are able to access the floodplain. *Bankfull width-to-depth ratio* indicates the shape of the channel, and is the ratio of bankfull width to mean bankfull depth. Bankfull stage is the point at which the stream accesses its floodplain and is a required measurement in order to determine width-to-depth ratios. It is synonymous to the flood stage, has an average return interval of 1.5 years (Leopold, 1964), and is considered the channel forming flow. Width-to-depth ratios indicate whether the stream is wide and shallow or narrow and deep. *Sinuosity* refers to the extent with which a stream meanders across the landscape. Highly sinuous streams have many meanders and curves, while streams with low sinuosity are straighter with few meanders and curves. Gradient is the slope or steepness of the stream while the *dominant channel substrate* refers to the size of particle or rock that covers the stream channel. The following discussion provides a general description of each of the Rosgen Stream Types found within the surveyed reaches of the watershed (see Step 4 for desired conditions and further stream type descriptions, including illustrations).

Rosgen A stream types are associated with landforms of high relief, are deeply incised and characterized by steep gradients. They typically have cascading, step/pool morphology with high energy, sediment supply and transport potential. Rosgen B stream types typically occur on narrow, gently sloping valleys and terrain and are characterized by moderate gradients and colluvial deposition. They are riffle-dominated channels with infrequently spaced scour pools. These stream types are typically very stable and usually found in forested systems where large woody debris plays an important role in pool formation.

Rosgen C streams types are associated with broad alluvial valleys with well-defined floodplains. They are low gradient, meandering streams characterized by riffle/pool sequences and point bars.

Rosgen E stream types are also found in broad alluvial valleys and meadows with well-developed floodplains. They are low-gradient, highly sinuous streams that are stable due to well-vegetated banks. When vegetation is lacking these channel types are highly sensitive to disturbance, which may result in increased levels of streambank erosion and downcutting. The E stream type provides excellent fish habitat through undercut banks, clean spawning gravels, and numerous deep pools. Data collected from stream surveys in both the Upper Sycan River and Chewaucan River watersheds indicate that E stream types are expected in low gradient meadow reaches with a drainage area of *less than* 18 square miles (by contrast, Rosgen C stream types are expected where drainage areas *exceed* approximately 18 square miles).

Paradise Creek Subwatershed: The following tables (Tables 3.6, 3.7, and 3.8) are a summary of the types of stream channels that occur within the surveyed reaches of Paradise, Crazy, and Watson Creeks. When two or more stream types are

listed for a reach, the dominant is listed first.

Table 3.6. Paradise Creek – Rosgen Stream Types

Reach Information					Rosgen Stream Type(s) and Associated Bankfull W/D Ratio	
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	0.7	USFS	10	1	C	17
2	2.1	USFS	14	2-4	B, C	23
3	2.0	USFS	13	1	C, B	20
4	0.6	USFS	13	1	C, B	19
5	0.8	USFS	6	1	C, E	14
6	0.4	USFS	4	<1	E	19
7	0.7	USFS	3	<2	E	11
8	1.2	USFS	4	4	E, B	10
9	0.5	USFS	4	8	A, E	10

Table 3.7. Crazy Creek – Rosgen Stream Types

Reach Information					Rosgen Stream Type(s) and Associated Bankfull W/D Ratio	
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	1.7	USFS	6	3	E_b, C_b	10
2	1.4	USFS	5	1	E	5
3	0.8	USFS	5	1	E	6
4	0.6	USFS	4	1	E	4
5	0.9	USFS	4	1	E	4
6	0.9	USFS	3	1	E	4
7	0.3	USFS	3	2	E	6

E_b or C_b refers to E and C stream types with steeper gradients (2-4%)

Table 3.8. Watson Creek – Rosgen Stream Types

Reach Information					Riparian Area Vegetation and Associated Bank Stability	
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	1.4	USFS/ Private	9	2	E, C	12
2	1.5	USFS	8	2	E, C, B	12
3	0.9	USFS	7	2	E, C, B	11
4	1.1	USFS	6	2	E, C, B	12
5	0.8	USFS	5	1	E, C, B	10
6	0.5	Private	5	1	E	10

Long Creek Subwatershed: No surveys occurred within this subwatershed. The lower portion of Long Creek is perennial, while the remaining channels within the subwatershed are intermittent and transport water only during spring snowmelt and intense thunderstorm events. Stream channels within this subwatershed are typically characterized as Rosgen B stream types, with small inclusions of Rosgen C stream types in the lower gradient, depositional reaches.

Upper Sycan River Subwatershed: The following tables (Tables 3.9 and 3.10) are a summary of the types of stream channels that occur within the surveyed reaches of the Sycan River and Skull Creek. When two or more stream types are listed for a reach, the dominant is listed first.

Table 3.9. Sycan River – Rosgen Stream Types

Reach Information					Riparian Area Vegetation and Associated Bank Stability	
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	2.3	USFS	43	2	C	57
2	1.6	USFS	42	2	B	30
3	1.3	USFS	33	3	B	28
4	4.3	USFS	38	3	B	37
5	1.9	USFS	30	3	B	24
6	0.8	USFS	30	2	C	34
7	1.9	USFS	24	1	C	21
8	1.5	USFS	22	3	B, C	19
9	2.4	USFS	22	2	B	16
10	1.6	USFS	20	1	C, B	18
11	0.6	USFS	19	2	C	22
12	3.2	USFS	12	1	C, E	12
13	4.0	USFS	4	2	E, C	12

Table 3.10. Skull Creek – Rosgen Stream Types

Reach Information					Riparian Area Vegetation and Associated Bank Stability	
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	1.4	USFS	4	1	E, C_b	5
2	0.4	USFS	4	<1	E	9
3	1.9	USFS	3	<1	E	3
4	1.1	USFS	3	<1	E	4
5	1.1	USFS	3	2-4	E_b	4
6	0.5	USFS	1-2	2-4	E_b	7

E_b or C_b refers to E and C stream types with steeper gradients (2-4%)

Habitat for Aquatic Species

Key Question 3: Are the channels providing adequate fish habitat?

Methodology:

1) Large Woody Debris (LWD) - Large wood was counted and classified into two categories. For ponderosa pine and mixed conifer sites, LWD was classified as 35' long with the small end being at least 20" in diameter. In lodgepole pine sites (LP), LWD was classified as 35' long with the small end being at least 12" in diameter. In both cases, LWD had to be within the bankfull dimensions of the channel to be counted. These guidelines are form INFISH.

2) Pools - To be classified as pool, two conditions were required. First, a pool needed to span the entire stream channel. Second, pool length needed to be longer than its width. Using these criteria, pocket pools that occur in the middle of channels were not counted. Large pools are those with depths greater than 3 feet.

3) Spawning Gravel Fines – Bulk samples of spawning gravel were acquired through the insertion of a cylinder into the streambed and extracting the gravel from the cylinder. Five samples were taken at each site, at pool tail crests or other areas that provided suitable spawning gravels. The samples were then taken to the Fremont National Forest Engineering and Soils Lab where they were dried, and passed through a series of sieves to determine the percent of fines less than 6.4 mm.

4) Stream Temperature – Stream temperature information was gathered with continuously recording thermographs, placed in strategic location throughout the watershed. The sensors were placed in moving water, and were calibrated prior to installation.

5) Fish Passage - The length, diameter, and slope of culverts occurring in a surveyed stream, or other perennial stream, were measured. Then, based on the drainage area above the culvert, the average spring flow was calculated. Using the culvert dimensions and flow information, it was determined whether or not the velocities of water flowing through the culvert exceeded the sustained swimming speed of trout. In addition, the presence or absences of jumping pools were documented, and the jump height was measured.

The summary tables that follow describe current fish habitat conditions in all stream reaches surveyed within the watershed. Using methods described in the beginning of this chapter, habitat conditions are summarized based on the following parameters: large woody debris, pools, spawning gravel fines, stream temperature, and fish passage. For reach locations refer to Figure 5.3 – Upper Sycan Watershed Reach and Monitoring Locations.

Paradise Creek Subwatershed: The Forest Service portions of three streams were surveyed within this subwatershed. Nearly 9 miles of Paradise Creek was divided into nine reaches; Crazy Creek was divided into seven reaches, which totaled nearly 7 miles in length; and Watson Creek was divided into six reaches that totaled just over 6 miles in length. The following tables (Tables 3.11, 3.12, and 3.13) are a summary of information collected for several elements that describe fish habitat within Paradise, Crazy, and Watson Creeks.

Table 3.11. Paradise Creek – Fish Habitat Elements

Reach Information					Habitat Elements						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Potential Fish Passage (Culvert) Concern
									(°C)	(°F)	
1	0.7	USFS	10	1	6	46	9	19	19.7	67.5	No
2	2.1	USFS	14	2-4	5	96	6	15	NA	NA	Yes
3	2.0	USFS	13	1	3	80	3	NA	NA	NA	No
4	0.6	USFS	13	1	8	71	2	NA	NA	NA	No
5	0.8	USFS	6	1	**	61	5	NA	NA	NA	No
6	0.4	USFS	4	<1	**	108	3	NA	NA	NA	No
7	0.7	USFS	3	<2	**	106	0	NA	NA	NA	No
8	1.2	USFS	4	4	21	128	1	NA	NA	NA	No
9	0.5	USFS	4	8	22	131	0	25	14.3	57.7	Yes

NA – Information Not Available; ** - Habitat element not applicable for this reach
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Table 3.12. Crazy Creek – Fish Habitat Elements

Reach Information					Habitat Elements						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Potential Fish Passage (Culvert) Concern
									(°C)	(°F)	
1	1.7	USFS	6	3	41	139	0	13	17.1	63.0	Yes
2	1.4	USFS	5	1	20	153	1	NA	NA	NA	No
3	0.8	USFS	5	1	17	228	1	NA	NA	NA	No
4	0.6	USFS	4	1	**	131	0	NA	NA	NA	No
5	0.9	USFS	4	1	23	152	8	67	NA	NA	Yes
6	0.9	USFS	3	1	**	156	0	NA	15.8	60.0	No
7	0.3	USFS	3	2	9	226	0	NA	NA	NA	No

NA – Information Not Available; ** - Habitat element not applicable for this reach
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Table 3.13. Watson Creek – Fish Habitat Elements

Reach Information					Habitat Elements						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Potential Fish Passage (Culvert) Concern
									(°C)	(°F)	
1	1.4	USFS/ Private	9	2	2	76	28	NA	22.9	73.2	No
2	1.5	USFS	8	2	8	81	4	NA	22.2	72.0	No
3	0.9	USFS	7	2	1	132	1	20	NA	NA	Yes
4	1.1	USFS	6	2	5	115	1	NA	NA	NA	No
5	0.8	USFS	5	1	1	131	0	NA	NA	NA	No
6	0.5	Private	5	1	**	133	4	NA	NA	NA	No

NA – Information Not Available; ** - Habitat element not applicable for this reach
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Long Creek Subwatershed: No surveys occurred within this subwatershed. The lower portion of Long Creek is perennial, but due to prioritization--based on funding and time--this stream was not surveyed. Potential trout habitat occurs within Long Creek downstream of Forest Road 2901, however no fish have been observed upstream of Forest Road 28 -- which is approximately 2 miles downstream of the US Timberlands/National Forest boundary and 4 miles downstream from Forest Road 2901. If fish use the upper portion of Long Creek, it appears the timing of occupation is limited to spring months when sufficient flows exist. Fish do occupy the lower portion of Long Creek, but occur in lower numbers than other perennial streams within the watershed. Riffles, pools, and in-stream large wood were available and are conducive to trout viability. However, beyond early summer, the habitat becomes scarce because of decreased flows. There is a potential barrier to fish passage in Long Creek at the culvert on Forest Road 28.

Upper Sycan River Subwatershed: The entire 27 miles of the Sycan River, from its headwaters in the Hanan Trail Roadless Area to its entrance into the Sycan Marsh, was surveyed and divided into thirteen reaches. The other stream surveyed within this subwatershed is Skull Creek, which was divided into six reaches that totaled six miles in length. The following tables (Tables 3.14, and 3.15) are a summary of information collected for several elements that describe fish habitat within the surveyed reaches of the Sycan River and Skull Creek. There were six additional culverts surveyed within this subwatershed (Refer to Figure 5.2 – Upper Sycan River Watershed Road Locations).

Table 3.14. Sycan River – Fish Habitat Elements

Reach Information					Habitat Elements						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Potential Fish Passage (Culvert) Concern
									(°C)	(°F)	
1	2.3	USFS	43	2	3	21	23	24	19.8	67.6	No
2	1.6	USFS	42	2	8	26	18	NA	NA	NA	No
3	1.3	USFS	33	3	6	45	13	NA	NA	NA	No
4	4.3	USFS	38	3	12	28	22	NA	19.6	67.3	No
5	1.9	USFS	30	3	22	32	19	NA	NA	NA	No
6	0.8	USFS	30	2	16	22	5	14	NA	NA	No
7	1.9	USFS	24	1	11	32	8	NA	NA	NA	No
8	1.5	USFS	22	3	24	29	3	NA	NA	NA	No
9	2.4	USFS	22	2	22	55	14	NA	NA	NA	No
10	1.6	USFS	20	1	17	53	9	NA	NA	NA	No
11	0.6	USFS	19	2	3	52	7	NA	NA	NA	No
12	3.2	USFS	12	1	**	48	19	20	15.9	60.6	No
13	4.0	USFS	4	2	8	75	1	8	15.2	59.4	Yes

NA – Information Not Available; ** - Habitat element not applicable for this reach
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Table 3.15. Skull Creek – Fish Habitat Elements

Reach Information					Habitat Elements						
Reach	Reach Length (miles)	Owner	Wetted Width (')	Gradient (%)	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Potential Fish Passage (Culvert) Concern
									(°C)	(°F)	
1	1.4	USFS	4	1	22	209	0	NA	17.5	63.5	No
2	0.4	USFS	4	<1	11	195	0	NA	NA	NA	Yes
3	1.9	USFS	3	<1	4	183	3	NA	17.5	63.5	Yes
4	1.1	USFS	3	<1	6	168	0	NA	NA	NA	No
5	1.1	USFS	3	2-4	19	174	0	NA	NA	NA	No
6	0.5	USFS	1-2	2-4	6	138	0	NA	NA	NA	No

NA – Information Not Available; ** - Habitat element not applicable for this reach
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

Water Quality

The tables shown above are a summary of the habitat information collected for those streams and stream reaches where 1998 and 1999 stream surveys occurred. Other water quality information (stream temperatures, sediment samples, and macroinvertebrates) was, or previously had been, collected for other sites within the watershed. A summary of the water quality information useful for aquatic habitat discussions within the watershed is summarized below.

The Oregon Department of Environmental Quality has listed two streams within the Upper Sycan Watershed on their ``303d' list (a list of streams that do not meet the requirements of the Clean Water Act). Streams and criteria listed in the 1998 303(d) list are shown in Table 3.16 and on Figure 3.1. The two stream segments are listed due to high summertime stream temperatures. Stream temperatures, as well as fine sediment will be discussed as part of this assessment. State water quality parameters of dissolved oxygen, bacteria, total dissolved solids and toxic pollutants are not addressed as separate subjects because long-term monitoring data for these parameters are not available. Field samples were taken at the mouth of the watershed during August 1999, with pH recorded at 8.15 (within ODEQ standards of 6.5-9.0) and dissolved oxygen recorded at 7.52 mg/l (below ODEQ standard of >8.0 mg/l).

Table 3.16 - Streams on the 1998 303(d) List

Stream Name	Description	Segment	Parameter/Criteria
Paradise Creek	Mouth to Headwaters	43A-PARA0	Temperature / Rearing 17.8°C (64°F)
Sycan River	Mouth to Rock Creek	43A-SYCA0	Temperature / Rearing 17.8°C (64°F)

1. Stream Temperatures

Stream temperatures are mainly influenced by the amount of stream flows, the amount of topographic and vegetative shading from direct solar radiation, channel morphology, and distance from the watershed divide or groundwater inflow. Reductions in stream shading as a result of land management activities or natural disturbance can increase incoming solar radiation during the summer months and decrease longwave re-radiation during the winter months. This can lead to increasing summertime maximum stream temperatures and diurnal fluctuations, and decreased winter temperatures, which may lead to icing. Small, shallow streams that do not have significant groundwater inflow or vegetative cover show the largest changes in stream temperatures. Stream temperature increases are additive. Stream temperatures will not decrease merely from passing thorough a shaded reach, unless there is an inflow of cooler groundwater.

Stream temperature data collected during the summer months is available for Paradise Creek, Crazy Creek, Watson Creek, Long Creek, Skull Creek, Rifle Creek, Rock Creek, Boulder Creek, S. Fk. Sycan River and the Sycan River. Temperature is an important component of these streams as they support native salmonid fish populations. Results of stream temperature monitoring for the above mentioned streams within the watershed are shown in Table 3.17.

Fig. 3.1 Water Quality Limited (303d) Streams In The Upper Sycan Watershed

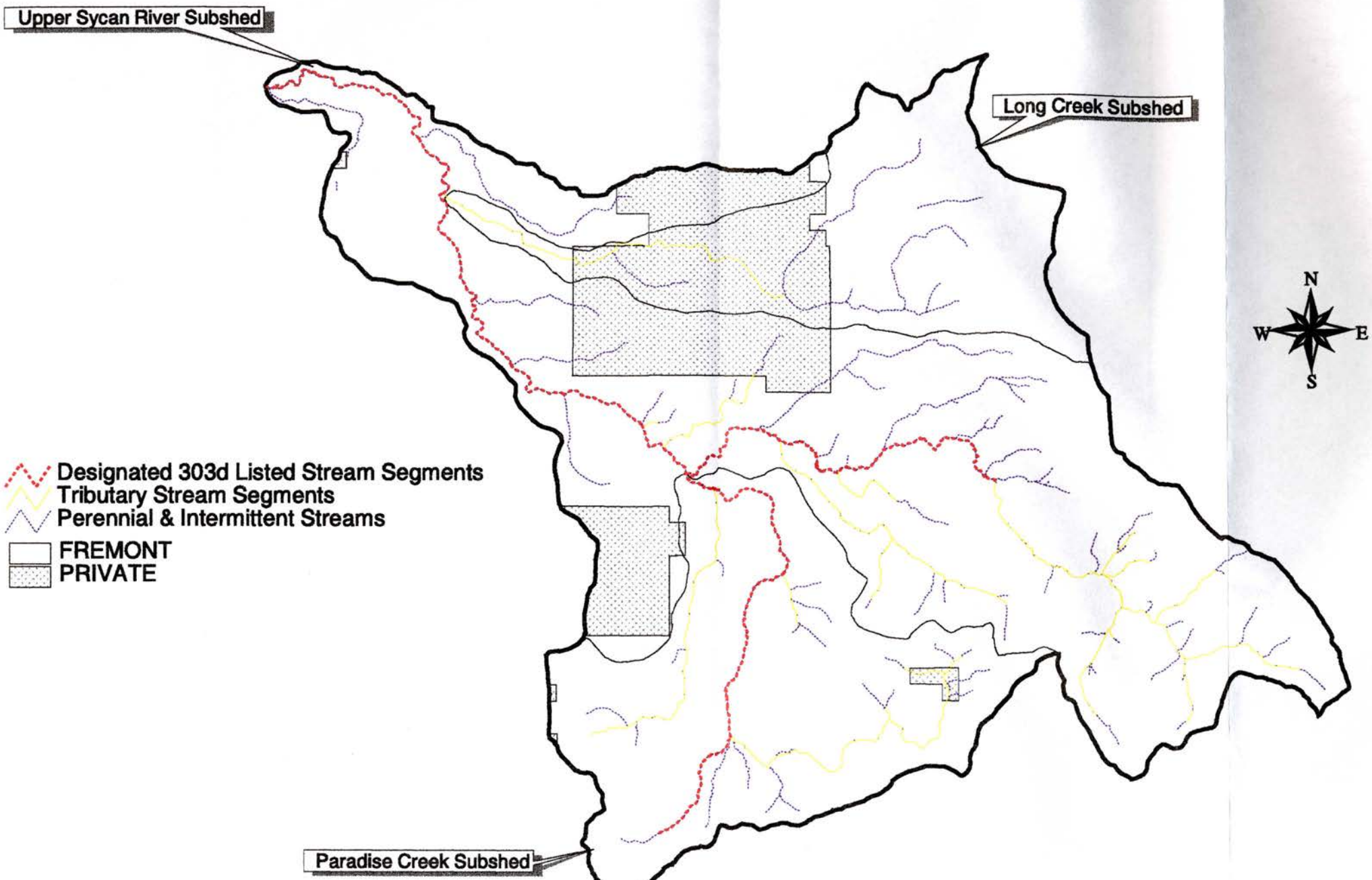


Table 3.17 - Maximum stream temperatures within the Upper Sycan Watershed.

Stream and Station #	7-Day Average Maximum Stream Temperature (°C)						
	1993	1994	1995	1996	1997	1998	1999
Paradise Creek (PD5660)	20.6	21.4	18.7	21.7	21.6	21.4	19.7
Paradise Creek (PD6300)							14.3
Crazy Creek (CZ5680)							17.1
Crazy Creek (CZ6160)							15.8
Watson Creek (WT6080)							22.9
Watson Creek (WT6250)							22.2
Long Creek (LN5200)							21.0
Skull Creek (SK5840)							17.5
Skull Creek (SK6080)							17.5
Rifle Creek (RF5920)							16.5
Rifle Creek (RF6340)							12.4
Rock Creek (RK6500)							15.3
Boulder Creek (BD6640)							11.9
S. Fk. Sycan River (SS6980)							13.7
Sycan River (SY5015)	24.1	23.3	17.3	20.9	22.4	18.8	19.8
Sycan River (SY5340)							19.6
Sycan River (SY5650)							19.5
Sycan River (SY5660)		25.2					
Sycan River (SY6565)							15.9
Sycan River (SY6620)							15.2

Important stream temperatures associated with Table 3.17:

- INFISH Riparian Management Objective and current US Fish and Wildlife standard for bull trout - rearing: 7-day maximum of 15.0°C (59°F)
- Current state water quality standard for stream temperature: 7-day maximum of 17.8°C (64°F)
- Stream temperature unfavorable to salmonids: 21°C (70°F)
- Stream temperature for optimum growth of salmonids: 15°C (59°F)

2. Fine Sediment

Fine sediments in spawning substrates were sampled at nine locations within the watershed. Sediment samples were taken from potential spawning habitat areas or potential redd areas in gravel/cobble portions of pool tail outs. An average of five samples per sampling site were obtained and a summary is shown in Table 3.18.

Table 3.18 - Fine Sediment in Spawning Substrates

Stream	Location	Percent Fines < 6.4 mm	Embryo Survival
Paradise Creek	Near FS Road 3323 (PD6320) - 1999	25	62
Paradise Creek	Near FS Road 3372 (PD5880) - 1999	15	83
Paradise Creek	Near FS Road 020 (PD5660) - 1999	19	76
Crazy Creek	Near FS Road 3372 (CZ5810) - 1999	13	87
Crazy Creek	Near FS Road 3323 (CZ6120) - 1999	67	3
Watson Creek	Near FS Road 3372 (WT6250) - 1999	20	74
Sycan River	Near Pikes Crossing (SY5650) - 1996	28	53
Sycan River	Near Pikes Crossing (SY5660) - 1999	14	84
Sycan River	Near FS Road 3380 (SY6570) - 1999	20	74
Sycan River	Near FS Road 3239 (SY5015) - 1999	24	65
Sycan River	Near FS Road 28 (SY6620) - 1996	17	79
Sycan River	Near FS Road 28 (SY6620) - 1999	8	95
S. Fk. Sycan River	Near FS Road 207 (SS6630) - 1999	14	84

Sieve analysis was performed in the laboratory to determine the percent fines by weight. Literature identifies detrimental fines as those passing the 6.4 mm sieve and smaller (Reiser and Bjornn 1979) in excess of 25-30% of the substrate material. From samples taken in 1995 and 1998, sediment in potential spawning substrates of perennial streams within the Upper Sycan Watershed were found to vary between 8% and 28%, with the only exception being the upper site on Crazy Creek (67%). According to these percentages, there appears to be only limited negative effects on aquatic macroinvertebrates and embryo survival.

3. Macroinvertebrates

Aquatic macroinvertebrates are an important component of aquatic ecosystems since they process vegetative material that enter streams and are an important food source for fish. Species of macroinvertebrates and macroinvertebrate ratings vary greatly depending on the chemical and biological conditions and amount of sediment in the stream. Aquatic macroinvertebrate samples along with physical habitat information and water quality test results were sent to the National Aquatic Ecosystem Monitoring Center in Provo, Utah. A Biotic Condition Index (BCI) was determined by the laboratory and is used in evaluation of the stream system. A summary of aquatic macroinvertebrate sampling in the Sycan River is shown in Table 3.19.

Table 3.19 - Macroinvertebrate BCI Rating

Stream	Location	1990 BCI Rating	1994 BCI Rating
Sycan River	Upstream of FS Road 3239 (SY5015)	79-87 (Good)	63 (Poor)

Conditions in 1994 do not appear as good as those in 1990, however, it is worth noting that 1994 was a very dry year with extremely low stream flows (stream flows were approximately 40% of the normal low flow for the Sycan River) which may have influenced BCI ratings.

4. Water Quality Summary

Less than half of the sites with stream temperature measurements were higher than recommended by the State, with most of the higher elevation sites of the watershed meeting Oregon State stream temperature standards. Sediment is generally within a range that is acceptable for fisheries with only one of the sites measured exceeding the recommended 30% level for fines.

Key Question 4: How are the above watershed conditions influencing native trout viability?

This section is a summary of the above elements and their cumulative effects on the watershed's, or a subwatershed's, ability to serve as a reserve for native trout. Discussions addressing this question, however, will not occur until Step 5 (Synthesis and Interpretation), after desired conditions and ratings have been described (Step 4). A brief description of fish populations and distribution within the watershed is provided below.

1. Fish Populations and Distribution

The Upper Sycan River above Sycan Marsh contains redband trout, Miller Lake lamprey, brook trout, and possibly Pit-Klamath brook lamprey and bull trout. Lamprey specimens were collected at several sites within the watershed during 1997 and 1998 with the majority being identified as Miller Lake lamprey. These species were once considered extirpated from the Klamath Basin, but this unique parasitic lamprey appears to be well distributed throughout the Upper Sycan Watershed. One other lamprey species suspected, but not confirmed, within the watershed is the Pit-Klamath brook lamprey – the specimens from a site on Watson Creek have not yet been positively identified but are thought to be Pit-Klamath brook lamprey.

Redband trout inhabit the Sycan River through the marsh upstream to the confluence of Rock Creek. Above this point, brook trout become the dominant species, eventually replacing redband trout in the headwater reaches. Population estimates conducted in 1996 by the Oregon Department of Fish and Wildlife, for those sections of the Sycan River where the two populations live in sympatry, were as follows: 0.407 fish/m^2 for 0+ brook trout and 0.4668 fish/m^2 for 1+ brook trout. Redband trout were generally found to have lower densities: 0.085 fish/m^2 for 0+ redband trout and 0.072 fish/m^2 for 1+ redband trout. These abundance estimates for redband trout are considered moderate as compared to other streams in eastern Oregon (Dambacher, unpublished data). Young of the year brook trout (age 0+) fork lengths are generally less than 60mm with adults collected as large as 210mm. Redband trout young of the year reach a length of 100mm with adults collected as large as 170mm. Many of the fish collected in 1996 had scars and/or lesions, which are the result of parasitic feeding of Miller Lake lamprey.

The last reported bull trout in the upper Sycan River above the Marsh was in 1969, and a hybrid was captured in the South Fork of the Sycan River in 1994 (Light et al. 1996). No sizable population is known to exist in the upper Sycan River and Buchanan et al. (1997) considers the population to be "probably extinct".

Increasing stream temperatures from localized droughts, global climatic warming, natural southern exposures, and anthropogenic land uses are a major limiting factor for Klamath Basin bull trout (Buchanan et al. 1997). Riparian shade, cold-water springs, or cold headwater streams are all essential to maintain cold water habitat for stenothermal bull trout. Reduced shade resulting from timber harvest, grazing and close proximity of roads can be found along several streams in the Upper Sycan watershed. Additionally, there may be a strong correlation between increased temperatures and adverse effects of non-native brook trout (Buchanan et al. 1997).

Introduced species are also an influencing factor on bull trout. Other non-native species, such as brown, brook, and lake trout, are thought to depress or replace bull trout populations (Dambacher et al. 1992; Howell and Buchanan 1992). Introduced species like brook trout may also displace bull trout in lower stream reaches, further reducing available habitat in many remaining headwater areas (Adams 1994; Leary et al. 1993). This is believed to be one of the major factors for the elimination of bull trout in the Upper Sycan River and it's tributaries. Hybridization with introduced brook trout is considered a serious threat (Dambacher et al. 1992; Kanda et al 1992; Leary et al 1991). Life history differences between the two species favor brook trout and can lead to displacement of bull trout, especially when combined with habitat degradation and higher reproductive potential (Leary et al. 1991). Hybridization has played a role in the elimination of bull trout in the Upper Sycan watershed as evidenced by the last documented bull trout collected was a hybrid (collected in 1994 by John Fortune, ODFW).

II. Vegetation

Fire was historically the major disturbance in the Upper Sycan watershed. All major vegetation types in the watershed have evolved to their current condition through a historical sequence that included fire of varying return interval (depending on vegetative type). There has been a general exclusion of fire beginning in about 1910. There have been 152 reported wildfire ignitions within the Upper Sycan watershed from 1949 through 1999, with most of those ignitions occurring in August (see the map *Fire Occurrence in Upper Sycan Watershed,* following page (3-15). The largest recorded fire was 4 acres, but most of the fires are controlled at less than 0.1 acres. Seventy five percent of the fires are lightning caused. Based on the typical fire size in the watershed, the fire behavior has not posed serious control problems. However, due to changes in forest stand structure and increases in fuel loading, any wildfire which would now occur within the Upper Sycan watershed has a high potential for severe fire behavior coupled with large-scale and undesirable effects.

Fire ecology, as it pertains to specific vegetative communities, is included in the discussions below.

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?

3. What rare or designated sensitive plants occur in the watershed?

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?

Forested Uplands

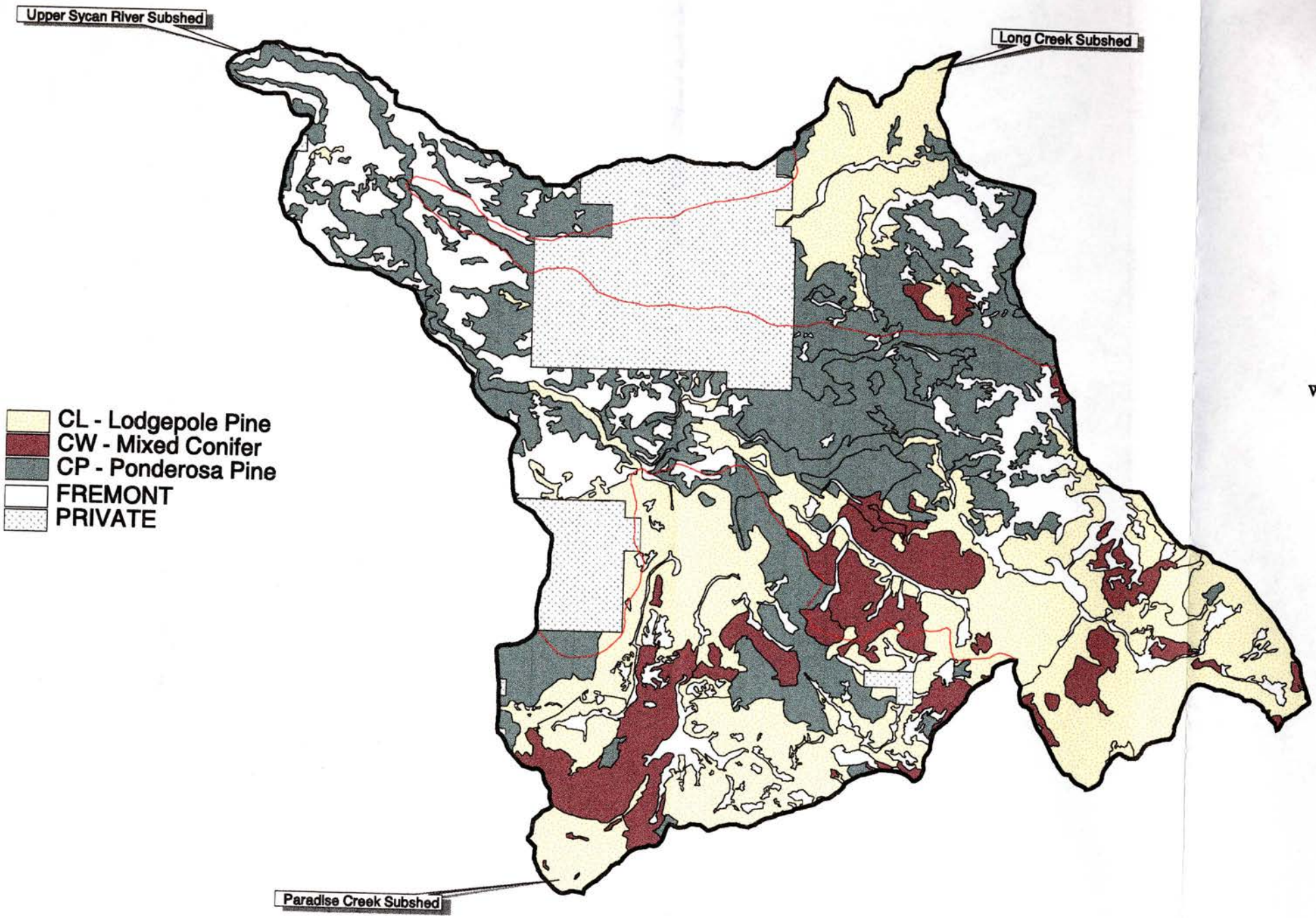
Forest vegetation occupies approximately 43,600 acres of National Forest lands, or 77% of the National Forest lands within the Upper Sycan Watershed. Three forest plant community types occur within the watershed. They are ponderosa pine, mixed conifer (a.k.a., ponderosa pine associated), and lodgepole pine. See the map *Forest Plant Associations In Upper Sycan Watershed* following page (3-15). Following that map is *Old Growth And Connectivity In Upper Sycan Watershed.*

PONDEROSA PINE

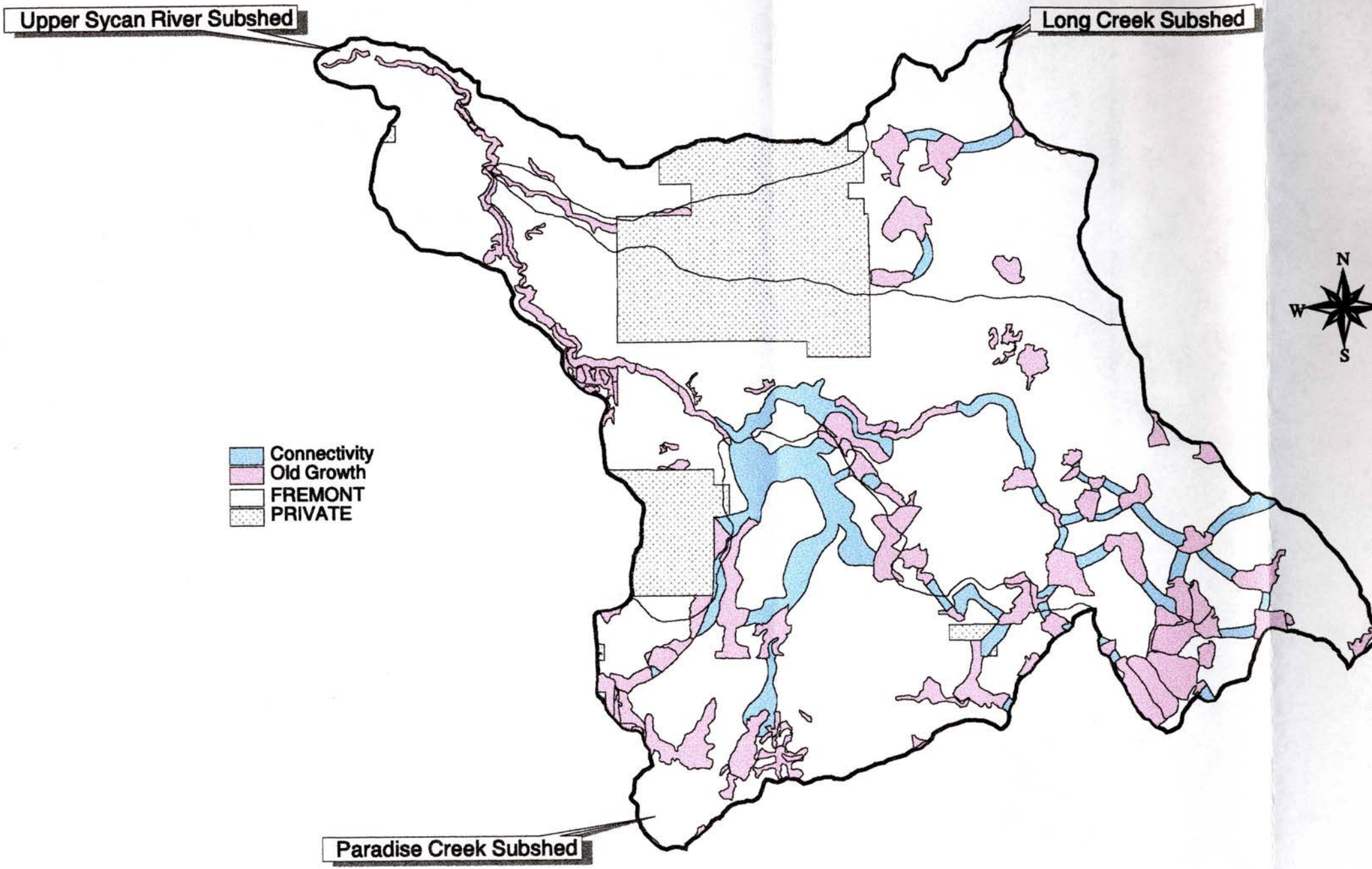
Ponderosa pine forests cover approximately 17,500 acres of the National Forest lands in the Upper Sycan watershed; this represents 31 percent of the National Forest lands in the watershed. Ponderosa pine plant communities exist and thrive at the drier, warmer end of the climatic spectrum of forest types. These conditions exist at lower elevations as well as southern and western exposures (high-energy sites). Ponderosa pine stands will grade into mixed conifer then lodgepole pine with increased elevation. Within most of the Upper Sycan, ponderosa pine stands are densely stocked with small diameter pines and are also experiencing abundant establishment of white fir in the higher elevations and young juniper in the lower elevations. Approximately 1,600 acres (9%) of the ponderosa pine stands are currently in an old-growth condition, using Hopkins definitions. These areas are typically distributed in small, scattered patches.

This forest type is dominated by ponderosa pine in both the overstory and the understory with the exception of extreme mesic and xeric conditions. On the very dry end, at lowest elevations or on excessively drained soils, western juniper makes up a portion of the tree layer. At the moister end, at higher elevations, and northern exposures, white fir will appear in stands that are beginning to grade into true mixed conifer types. Quaking aspen may be found within and adjacent to ponderosa pine stands. Aspen stands are small and very scattered across the landscape. These stands are usually associated with a micro site affording plenty of available moisture such as a spring or a perched water table. Most of these aspen stands show evidence of decline from grazing and forest encroachment.

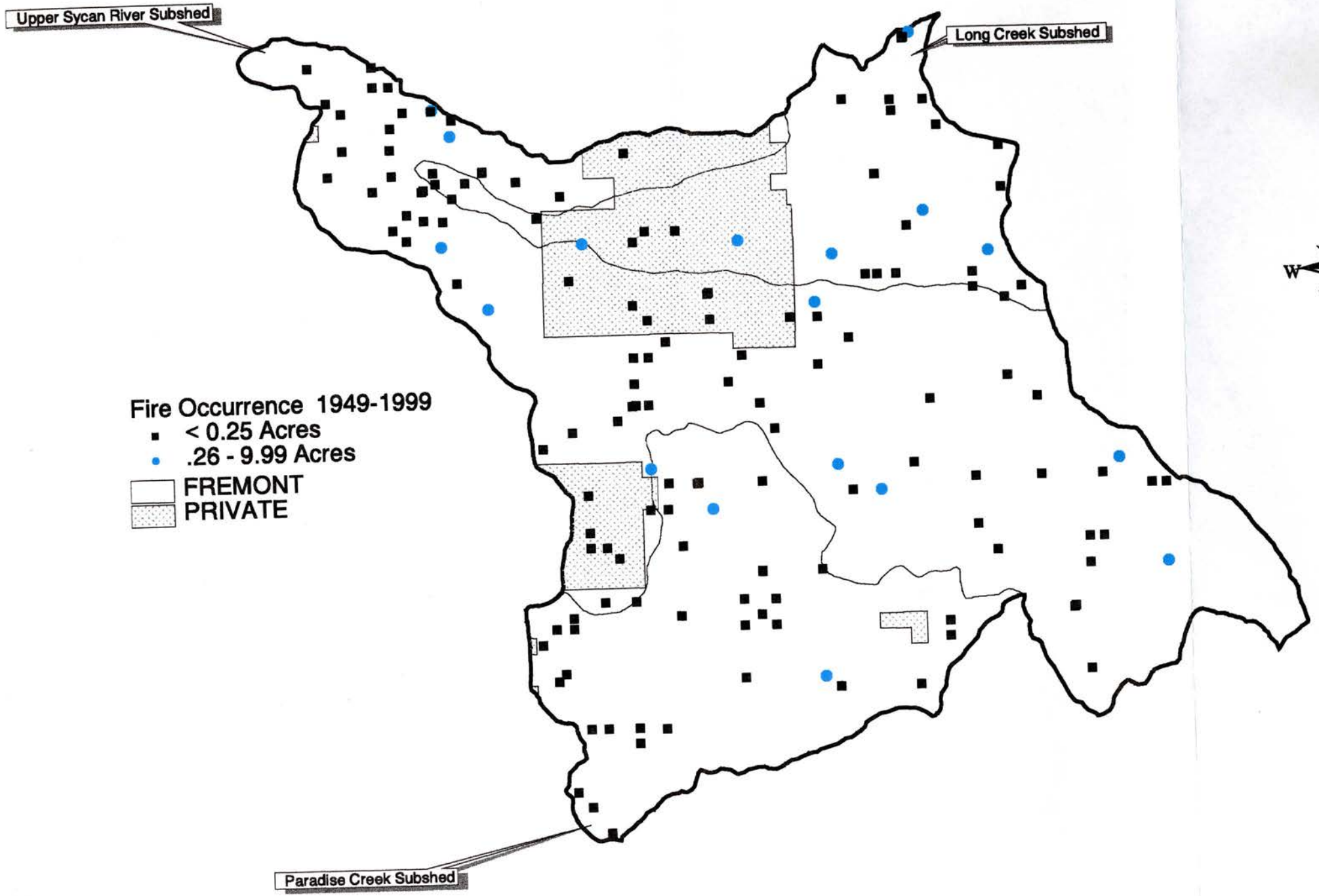
Forest Plant Associations In Upper Sycan Watershed



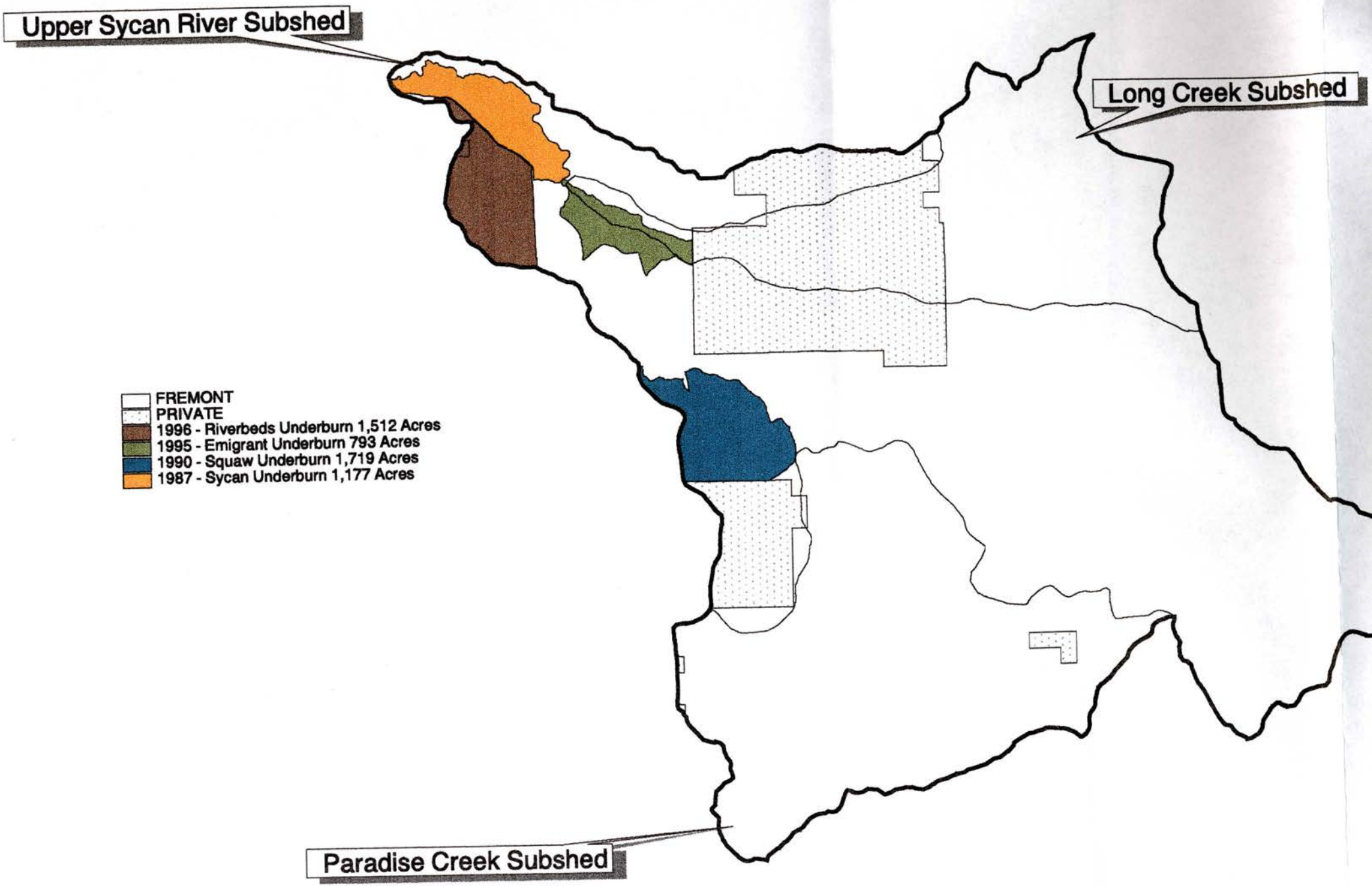
Old Growth And Connectivity In Upper Sycan Watershed



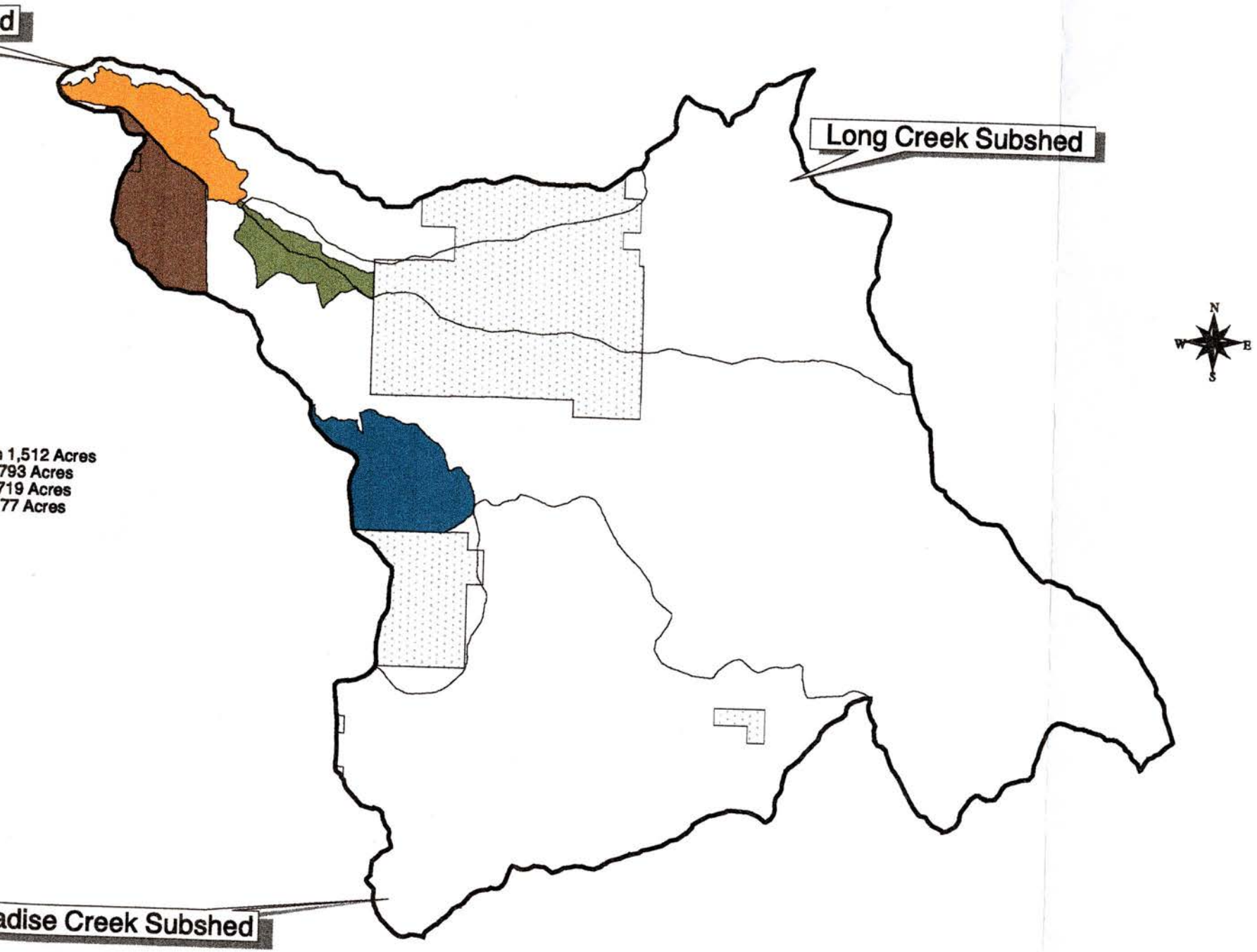
Fire Occurrence In Upper Sycan Watershed



Underburn In Upper Sycan Watershed



Upper Sycan Watershed



The ponderosa pine community types can support a significant shrub component. Big sagebrush, antelope bitterbrush, and mountain-mahogany are common on lower to moderate sites. Greenleaf manzanita and squawcarpet can be found on the higher sites. This shrub layer can cover up to 60 to 70% of the area. Heights can range from two to seven feet but generally are about two to four feet.

The herb/grass layer is highly variable with a diverse number of species occurring throughout the range (Hopkins 1979). Species such as bottlebrush squirreltail are common.

The mean stand productivity in terms of both wood and forage is highly variable depending upon the density of the stand. In relative terms ponderosa pine forests are considered to demonstrate low to moderate productivity. Mean wood productivity ranges from 42 to 54 cubic feet per acre per year.

1. Fire Ecology

Broad changes in stand structure and large-scale species conversions can be attributed to fire exclusion, historical grazing practices and timber harvest. Fire has played a profound role upon the development and structure of ponderosa pine stands within the Upper Sycan watershed as it has across the whole western United States. Fire's historical role in stand development is also discussed in Steps 4 and 5, beginning on page (4-11) and (5-32). Fire history studies in Oregon's ponderosa pine forests indicate a fire return interval of 3 to 50 years, depending on the site conditions and weather patterns (Agee 1993). In general, higher-elevation sites, or sites on the fringe of mixed-conifer forests, usually had longer fire-free intervals compared to lower-elevation sites.

The process of stand development in ponderosa pine forests is a result of the shade intolerance of ponderosa pine, periodic good years of seedling establishment associated with years of above normal precipitation, and frequent fire (Agee 1993). Gaps in the forest created by insects, wind, or disease and cleaned by a fire, allow the shade intolerant pine to become established. In this opening, the stand of young trees will be protected from fire because of lack of fuels on the forest floor, while the fire will burn under mature stands and remove any reproduction there. As the trees in the opening continue to grow, they provide enough fuel to carry the fire and thin the stand. These groups escape relatively quickly to the canopy and maintain codominance for very long periods of time. So, what appears to be an open "parklike" even-aged and single-storied structure, is actually characterized by groups of trees of varying ages. The age of codominants within a stand can typically range from 150 to 500+ years old

A fire management strategy of prevention, detection, and suppression has resulted in virtually all of the LOS ponderosa pine stands developing multistory structures. A limited number of mid seral stands do exhibit single storied structure. Current conditions (densely stocked stands with variable age class) increase the likelihood of large scale, stand-replacing wildfires. Fire in the Fremont's ponderosa pine forests in the past five years (Thomas Creek, Robinson Springs, Alder Ridge etc.) is much more intense than the fire behavior that was typical 100 years ago. Recent management activities have included the use of fuels reducing prescribed fire. During the past 13 years, four different prescribed fire projects have been implemented within the watershed. These include the Sycan Underburn (1987, 1,200 acres), Squaw Underburn (1990, 1,700 acres), Emigrant Underburn (1995, 800 acres) and the Riverbeds Underburn (1996, 1,500 acres). See the map *Underburn in Upper Sycan Watershed*, following page (3-15).

2. Insects

Western pine beetle, mountain pine beetle, turpentine beetle, and pine engraver are the four most important insects affecting ponderosa pine forests in the Upper Sycan watershed.

Western pine beetle (WPB) kills large ponderosa and sugar pine, singly, or in small groups, especially if these trees are stressed by competition for moisture. Survey estimates of mortality from western pine beetle are not accurate or available. The risk of attack is loosely tied to stand density but less so than with other bark beetles. Stands with white fir understories are particularly at risk. Very little recent mortality can be observed within the Upper Sycan Watershed.

Mountain pine beetle will typically infest and kill pole and sapling sized ponderosa in groups of less than one acre. This beetle also attacks mature or stressed sugar pine. Stand risk to attack is directly linked to density thresholds. Currently, most unmanaged post and pole stands in the Upper Sycan Watershed are at high risk of mountain pine beetle infestation. Stands, which have been tended by thinning or prescribed underburning, appear to be resistant.

Typically **turpentine beetle** is a secondary invader, present in trees that have succumbed to bark beetles or injured by fire scorch. Information on current distribution within the Upper Sycan Watershed is not available.

The **pine engraver** is a pest of sapling to small saw timber sized ponderosa pine. The beetles infest logging slash, fire-killed trees, or windthrows. In addition to killing small trees, the beetle will kill the tops of larger ponderosa. Pine engraver mortality is much less severe on the Fremont than it is in the Sierra Nevada region (Eglitis, et al.1993).

3. Disease

Annosus and Armillaria root disease, and dwarf mistletoe are the three most important diseases within ponderosa pine communities in the Upper Sycan watershed. Of lesser importance is comandra blister rust.

Annosus root disease is one of the most important forest diseases on the Fremont N.F. The P-strain (*H. annosum*) produces the disease that affects ponderosa pine. Surveys on the Fremont (Hopkins et al, 1988) indicate the P-strain is a management concern on marginally productive ponderosa pine sites. Infection has been most notable in southern portions of the Fremont NF and District with no P-strain having been documented within the Upper Sycan watershed (Hopkins et. al. 1988). There also appears to be a strong association between P-strain annosus and soil compaction. Multiple timber entries have exacerbated the problem on portions of the Forest. Although no P-strain has been reported within the Upper Sycan Watershed, there are many areas at risk of infection and prevention strategies should be prescribed.

The fungus *Armillaria ostoyae* causes **Armillaria root disease**. Throughout its distribution, this fungus is extremely variable in terms of its virulence (Eglitis 1998). Ponderosa pine does not have as high of infection risk as the true firs, but it can become infected when stressed by such factors as competition or drought. Armillaria has never been documented within the Upper Sycan watershed. Stands at risk of infection are similar to those of Annosus root disease.

Dwarf mistletoe is a species-specific parasitic plant. There is a species of dwarf mistletoe specific to ponderosa pine, which is common within the Upper Sycan watershed. Spread and damage is greatest in pure ponderosa stands with a multi-layered canopy. Heavily infected trees will grow at less than half the expected growth rate and have a much higher mortality rate. Though not mapped, it is suspected that this disease occurs within approximately 1/4 of its host stands. Some of the heaviest mistletoe in ponderosa pine on the district occurs in the northwestern corner (stringer country) of the watershed and is most damaging on drier sites.

Comandra blister rust is the pathogen responsible for creating the "spire tops" on old growth ponderosa pine. Very little documentation exists concerning this disease. Ecologists suspect that up to 10 percent of trees in the historic "parklike" stands exhibited spire tops caused by this disease (Hopkins 1993). This process helped maintain snag habitat in an environment where true snags burned up quickly.

4. Management

Disturbances due to management practices, this century, have shaped the structural stage distribution of ponderosa pine within the watershed. Large ponderosa pine has always been the premium timber product produced on the Fremont N.F. Timber extraction within the ponderosa pine types has been extensive across the watershed. Early activities were designed to conserve and protect the resource while capturing mortality through **single tree selection**. Later activities in the 1970's and 80's removed the majority of mature ponderosa overstory to release the younger faster growing understory. Though up to 40% of today's late and old ponderosa stands remain, they do not retain the single mature canopy structure that was expressed historically. In fact, very little of the historic single story LOS remains. Areas where overstories have been almost completely removed and the advanced regeneration managed have yielded most of today's mid seral component. Many of these **overstory removal** prescriptions have had a pre-commercial thinning treatment performed. **Clear-cutting** within

ponderosa pine began to occur in the 1980's but was not a dominant practice. This silvicultural system was used to clean dwarf mistletoe from the stands and was used most notably within fringe stands along the Sycan River and above the Sycan Marsh. The last timber entry, in ponderosa pine type, was a clear-cut/overstory removal sale in the late 1980's. Currently, these early seral areas exhibit densities that predispose the stands to attack by bark beetles, particularly mountain pine beetle.

Wherever openings were created and especially when cleaning out mistletoe, pine plantations were established (approximately 2,000 acres). These areas were planted at densities of 300 to 500 trees per acre. Due to the risks of animal damage from gophers, porcupines and big game browse, a considerable investment was spent protecting seedlings. Being relatively successful, most plantations have been scheduled for a thinning before they reach a mid-seral size/structure.

MIXED CONIFER (Pine Associated)

Mixed conifer forests cover approximately 6,000 acres of the National Forest lands in the Upper Sycan watershed; this represents 11 percent of the National Forest lands in the watershed. Relative to the ponderosa pine types, these stand types exist at higher elevations and northern exposures (low energy sites). Always, ponderosa pine plays the seral role while white fir is the climax species. Within these plant communities, ponderosa pine and white fir will dominate with highly variable cover percentages that range from 5 to 75%. Lodgepole pine can also become a component in the stand but is not usually in a dominant or codominant position, though it will be an early pioneer following disturbance. Approximately 1,650 acres (27%) of the mixed conifer stands are currently in an old-growth condition, using Hopkins definitions.

Species composition depends upon the position of the stand within the landscape, past disturbance regimes, and moisture/site relations. In most cases within the Upper Sycan watershed, ponderosa pine will be the dominant species in the overstory. Species composition in the understory depends upon disturbance regimes, topography, overall stand density, and moisture/nutrient relations. Ponderosa pine is out-competed when shade tolerant white fir or fast growing lodgepole are present. Most mixed conifer stands today exhibit abundant white fir in the understory that relates to the area's fire ecology. Some forest stands that are classified as mixed-conifer today may historically have been ponderosa pine forests. Absence of large-diameter white fir may indicate that the stand is not a true mixed conifer.

Relative productivity of mixed conifer sites is rated moderate to high. Mean wood productivity ranges from 45 to 69 cubic feet per acre per year.

1. Fire Ecology

The fire regimes affecting mixed conifer forests across the west are highly variable. Historical fire return intervals within true mixed-conifer forests are probably between 25 and 75 years. Where white fir occurs with ponderosa pine, fire-return intervals are probably at short end of the range. In the lodgepole pine/white fir associations, the fire-return interval is probably on the longer end of the range. As fire return intervals lengthen, likely due to cooler, wetter climate, there is a tendency to have higher proportions of white fir in the overstory (Agee 1993).

Ponderosa pine has a competitive advantage in the presence of fire that it loses in a fire free environment. Today most mixed conifer stands in the Upper Sycan watershed exhibit abundant white fir in their understory. The fire free period experienced this century has caused mixed conifer stands, which evolved similar to open ponderosa stands, to become dense stands of true fir with unprecedented stocking levels. As a result, fires that were historically a maintenance event would today likely be a high intensity stand replacement event.

2. Insects

In addition to the insects that affect ponderosa pine, fir engraver beetle, Modoc budworm and the Douglas-fir tussock moth are important insects with respects to white fir. Although threats by insects and diseases seem numerous, they tend to be species specific. Mixed conifer stands typically provide a greater resiliency to insect attack than stands that are composed of a single species.

The **fir engraver beetle** is an opportunist that will attack and kill white fir under stress (Eglitis, et al. 1993). Periods of drought generally correlate to beetle attacks within the Upper Sycan watershed. The stands at highest risk are those occupying sites at the drier fringe of their range.

The **Modoc budworm** has a small natural range between NE California and SE Oregon. The insect is considered to be less aggressive than the western spruce budworm with sporadic outbreaks that haven't caused severe damage to host stands. The Modoc budworm is not a primary mortality agent. In extreme cases, trees can be totally defoliated. The weakened tree then succumbs to more aggressive agents such as fir engraver (Eglitis, et al. 1993)

Information on current distribution in the Upper Sycan Watershed is not available, though it is not uncommon to find the larvae feeding on white fir foliage. There has never been a reported outbreak to the extent that trees had been severely defoliated. Due to fire exclusion, host stands have been increasing across the landscape. The stands at highest risk are those multistory stands, heavy to white fir, under stress from density or drought.

The **Douglas-fir tussock moth** has potential to be an important insect within white fir stands. Annual "early detection" monitoring has yet to detect harmful population levels on the Fremont NF, nor has there ever been a documented outbreak on this forest.

3. Disease

Because ponderosa pine in an integral species in mixed conifer stands in the Upper Sycan watershed, Annosus and Armillaria root disease, and dwarf mistletoe are important diseases to these stands. In addition, Indian paint fungus among others are important stem decay pathogens in white fir.

S-strain Annosus, which infects only white fir, has been documented throughout the Fremont NF including the Upper Sycan watershed, within examples of every mixed conifer plant association. Multiple entries within stands of high white fir composition tend to aggravate the occurrence of this root disease.

Armillaria root disease prefers white fir to pine. Though probably present within the Upper Sycan watershed there are no documented infection centers.

There is a species of **dwarf mistletoe** that infects only white fir. Due to the fact that white fir has expanded its presence so quickly across the landscape, this mistletoe is not distributed as widely as the ponderosa species. Information on current distribution in the Upper Sycan watershed is not available.

Indian paint fungus affects only white fir within the Upper Sycan watershed. It becomes established by infecting shade-killed twiglets on suppressed trees. Once the infection point heals, the fungus remains dormant for up to 50 years or longer. Death of large branches, mechanical wounds, insect patch kills, and fire scars appear to activate dormant fungus infections (Aho 1981). The percentage of trees which are of less commercial value as a result of these pathogens varies widely from drainage to drainage but can run as high as 30 to 50 percent. Fir damaged during management activities runs the risk of accelerating development of these decays and will likely lead to substantial decay losses by Indian paint fungus and others. It is thought that mechanical wounds today play the same role as fire scars had played historically in initiating stem decays in white fir (Aho 1981). Information on current distribution in the Upper Sycan Watershed is not available.

4. Management

Management within the mixed conifer stands began much as it had with the ponderosa pine type. Protecting and capturing mortality of the valuable mature pine was paramount. By far, most of the intensive forest management practices occurring on the Fremont NF were implemented in these relatively productive mixed conifer types. Due to the management imposed fire free period partial **overstory removals** became practical and common. Valuable ponderosa was harvested and the fast growing white fir understory was treated as advanced regeneration thus avoiding the cost of artificial regeneration. Many of these areas have had a pre-commercial thinning treatment done to them. **Clear-cutting** became common practice in the 1970's and 80's. The last timber entry into mixed conifer stands was under the Elementary and Taylor Timber Sales (completed in 1990), which featured clear-cut and overstory removal style silvicultural systems. Clear-cutting was

implemented when the fir understory was deemed too suppressed to be released.

Approximately 1443 acres of plantations have been created. Just as in the ponderosa pine types, these plantations were planted at densities, which would require subsequent pre-commercial thinning.

To date on the Fremont NF, very little prescribed underburns have occurred in mixed conifer types. The natural fuels underburn project plan addressed only treating ponderosa pine types.

LODGEPOLE PINE

As a species, lodgepole pine has the widest adaptive amplitude of any conifer on the Fremont National Forest. Lodgepole pine forests cover approximately 20,000 acres of the National Forest lands in the Upper Sycan watershed; this represents 36 percent of the N.F lands in the watershed. The lodgepole pine on the Fremont NF is of the subspecies *murrayana* (Sierran lodgepole). This subspecies does not have serotinous cones but is a prolific seed producer. This species is the most cold hardy of all the conifers on the Fremont. These stand types occur at the highest elevations within the watershed. Lodgepole pine is also found along edges of ponderosa pine and mixed conifer stands where the stands reach down into low laying areas where cold air becomes restricted (frost pockets) or in any concave topographic feature where cold air may become trapped. Between disturbances, lodgepole pine will frequently encroach into areas such as aspen and grass meadows. These areas tend to be too cold or wet for other conifers to grow well. Lodgepole pine is a seral species where it interfaces with most other conifers and will establish itself quickly following a disturbance. Being relatively short-lived it cannot compete successfully with ponderosa or white fir on such sites. Approximately 2,900 acres (14%) of the lodgepole pine stands are currently in an old-growth condition, using Hopkins definitions.

1. Fire Ecology and the Mountain Pine Beetle

Most of the lodgepole pine stands that occur on the pumice derived soils and in the "coldest" cold air pockets are considered climax lodgepole forest and no other species will succeed them. The fire regime connected with these type stands is considered to have a moderate severity. Combinations of low, moderate and high severity fires occur in space and time (Agee 1993). Fire studies completed on the Fremont show a fire return interval of 60 to 350 years (Stuart 1984). The average is probably found between 60 and 100 years, and areas of higher productivity (or adjacent to those areas) probably experienced fire return intervals on the more frequent end of the spectrum. Agee (1993) reports evidence of natural fires in Oregon's lodgepole pine that range from slow burning logs on the forest floor to stand-replacement crown fire driven by strong winds. Under some weather conditions, lodgepole pine acts as a barrier to fire spread because of the lack of understory vegetation. During some fire events in adjacent stands, even during summer, fire will not spread into climax lodgepole pine stands (Agee 1993), suggesting that these stands may be a natural fire barrier except under unusual fire behavior. However, large-scale fire driven by strong winds is also within the observed range of fire behavior in these forests. Several examples of past fires in lodgepole on the Paisley Ranger District were purely wind driven events (Watson and Timber Falls Butte fires).

The relationship between fire and insect is a cycle based upon the beetles' food base (lodgepole phloem). When a high proportion of the stand reaches approximately nine inches DBH, a beetle epidemic will begin. Natural regeneration quickly establishes and any advanced regeneration that gets released will respond and grow into the gaps created. Killed timber will fall to the ground within a 5-10 year period. Unless pushed by exceptional wind, subsequent fires vector along these decaying logs, many of which have decayed heartwood due to the partial insect kill. These fires of low to moderate intensity encourage secondary mortality by insects. Decay agents infect standing trees whose roots were damaged by the fire, another way of creating a decay column. The trees killed by either fire or insects form the next generation of logs, which will become ideal fire vectors in another 50-75 years. The next disturbance could be another insect attack, another fire of low to moderate severity, or perhaps a crown fire if conditions are right. A combination of these events can be combined across a landscape making for a diversity of age groups and structure within a large homogeneous stand.

Currently there is approximately 5,000 acres of insect disturbance within the watershed. There are apparently at least two time periods after a mountain pine beetle outbreak when fire could easily spread in this system: the first few years following tree fall and approximately 50 years later (Gara et al. 1985). The spatial scale and proximity of beetle outbreak areas determine the magnitude of a fire disturbance. The size of recent disturbances from insects, disease, fire and timber harvest is

much smaller than what was observed historically in similar forest types. Although 100 years of fire exclusion may not have significantly interrupted natural fire processes in a particular stand where the typical fire return interval is between 60 and 100 years, the geographic scale of disturbances has been significantly altered and has affected plant associations with shorter fire return intervals. For example, the lower elevation forests, now densely stocked with flammable material, have had the natural role of fire disrupted and are now susceptible to high-intensity fire that can easily spread to adjacent forest types and alter the fire regime in the mature lodgepole pine forests.

2. Insects

Within the Upper Sycan watershed, **mountain pine beetle** is the only primary insect disturbance agent related to lodgepole pine. The effects of this insect currently dominate portions of the Upper Sycan. During the summer of 1998, a dramatic increase in MPB mortality was observed which has involved approximately 5,000 acres of National Forest Lands west of Winter Ridge, in the northeast portion of the watershed. Most of the killed timber is mature lodgepole pine occupying dominant and codominant positions within late seral lodgepole pine stands. Many stands have lost the majority of their high crown cover. Mortality ranges between 10% and 80% of the overstory. This equates to 15 to 100 trees per acre. These lodgepole stands are behaving normally with respect to their age and susceptibility to beetle attack. Historically, fires tended to be small, infrequent and not much of an ecological factor in these plant communities. At these higher elevations with relatively high precipitation, the mountain pine beetle is the primary disturbance factor that recycles lodgepole pine at the landscape scale. These stands are abruptly dropping back to an earlier seral stage with a combination of natural and advanced regeneration quickly establishing the next generation of trees.

3. Disease

Dwarf mistletoe, pine needle cast, and western gall rust are the three most important diseases relating to lodgepole pine within the Upper Sycan watershed. Two other rusts are present in the watershed but very little documentation exists. They are stalactiform blister rust and comandra blister rust.

The heaviest infections of **dwarf mistletoe** occur in the higher elevations within the Hanan Roadless Area and the uplands above the South Fork of the Sycan River. The large area of lodgepole pine, west of Winter Ridge, is largely uninfected. The biology of this parasite is similar to that of the ponderosa pine variety, except that it will only infect lodgepole pine. An exception is that birds can be a more important vector of mistletoe in lodgepole pine than in ponderosa, particularly in stands along streams and meadows.

Pine needle cast affects lodgepole pine across the entire Upper Sycan Watershed. Needle casts are favored in situations where moist conditions prevail in early summer. Microsites, such as borders of wet meadows and riparian areas are high-risk areas. One good example of a recent infection is where Forest Road #30 crosses the Sycan River (Pike's Crossing). Needle casts have their greatest impacts in young even-aged stands or plantations, especially those established with offsite stock. Needle casts seldom kill trees directly but when severe, may predispose them to other agents. (Scharpf 1993)

Western gall rust is a common occurrence within lodgepole stands that developed in the cool moist draws across the Upper Sycan watershed. It is within these more moist areas that the disease seems to stay confined. Unlike most other rusts, western gall rust requires no secondary host.

4. Management

Unlike ponderosa pine, lodgepole products have been at the bottom rung of the economic ladder. Within the Upper Sycan, lodgepole stands tend to be large and old. Some of the earliest management activities in lodgepole pine types occurred in Upper Sycan. The Green Mountain, Eastside-Paradise, and Crazy Creek lodgepole sales, of the early 1970's, regenerated large blocks using the **seed tree** method. Average opening size exceeded 100 acres. The intent was to convert these late and old stands to younger more productive (and beetle proof) conditions. Later sales such as Cold Springs, Butter, and Coil (north of Lee Thomas Crossing), as well as Short, Edge, and Loco (west of Winter Ridge), created smaller seed tree openings (approx. 25 acres each). These openings were dispersed evenly across the sale area with the intent of maximizing edge for

big game. The Loco and Edge projects had been extended due to a high market for chips. Mechanical site preparation for natural regeneration was accomplished through biomass removal contracts. To date all of these contracts have been completed. Some ponderosa pine was planted on these sites. The ponderosa are growing well on the ridges but incurred frost damages elsewhere. Most areas became well stocked with over 500+ trees per acre. Pre-commercial thinning has been occurring across all but the most recent sale areas. Stands are being thinned to an average spacing of 15 to 18 feet. Analysis using FVS modeling showed this to be best for allowing stand growth to occur until trees begin to reach a commercial diameter. Ingrowth of lodgepole after thinning is being observed on many sites. These two-storied structures could incur density-related mortality sooner than the modeling projected.

The most recent management has occurred west of Winter Ridge. In efforts to maintain LOS stands, prescriptions had been designed to thin stands to maintain vigor while reducing risk of large-scale mountain pine beetle (MPB) outbreaks. MPB mortality is outstripping efforts to "beetle proof" stands west of Winter Ridge. Two schools of thought prevail as to why thinning increases a stand's resistance to mountain pine beetle attack. Thinning will increase the general vigor of individual trees, better enabling them to expel (blow out) the insect as they attempt to enter the tree (Mitchell, et. al. 1983). Bark beetles evolved to fly though a dense canopy in search of its host tree, and use pheromones to aggregate in order to over whelm the target. Thinning changes the microclimate within the canopy layer and can disrupt beetle behavior during dispersion (Schmitz, et. al. 1989). New sales such as Long and Acute are a combination thinning and salvage. Both of these sales will be active during the 2000 field season. A new lodgepole pine salvage sale is currently being planned in the northeast corner of the watershed on Winter Ridge.

No prescribed burning has occurred within any pure lodgepole pine types within the Upper Sycan watershed.

Non-Forested Uplands

The watershed is characterized by over 10,000 acres of non-forested vegetation. Several open ponderosa pine dominated communities are included in this discussion. Tables. 3.20a and 3.20b identify the approximate number of acres for each of these communities and displays the portions of non-forested plant associations that are in early, mid and late successional stages.

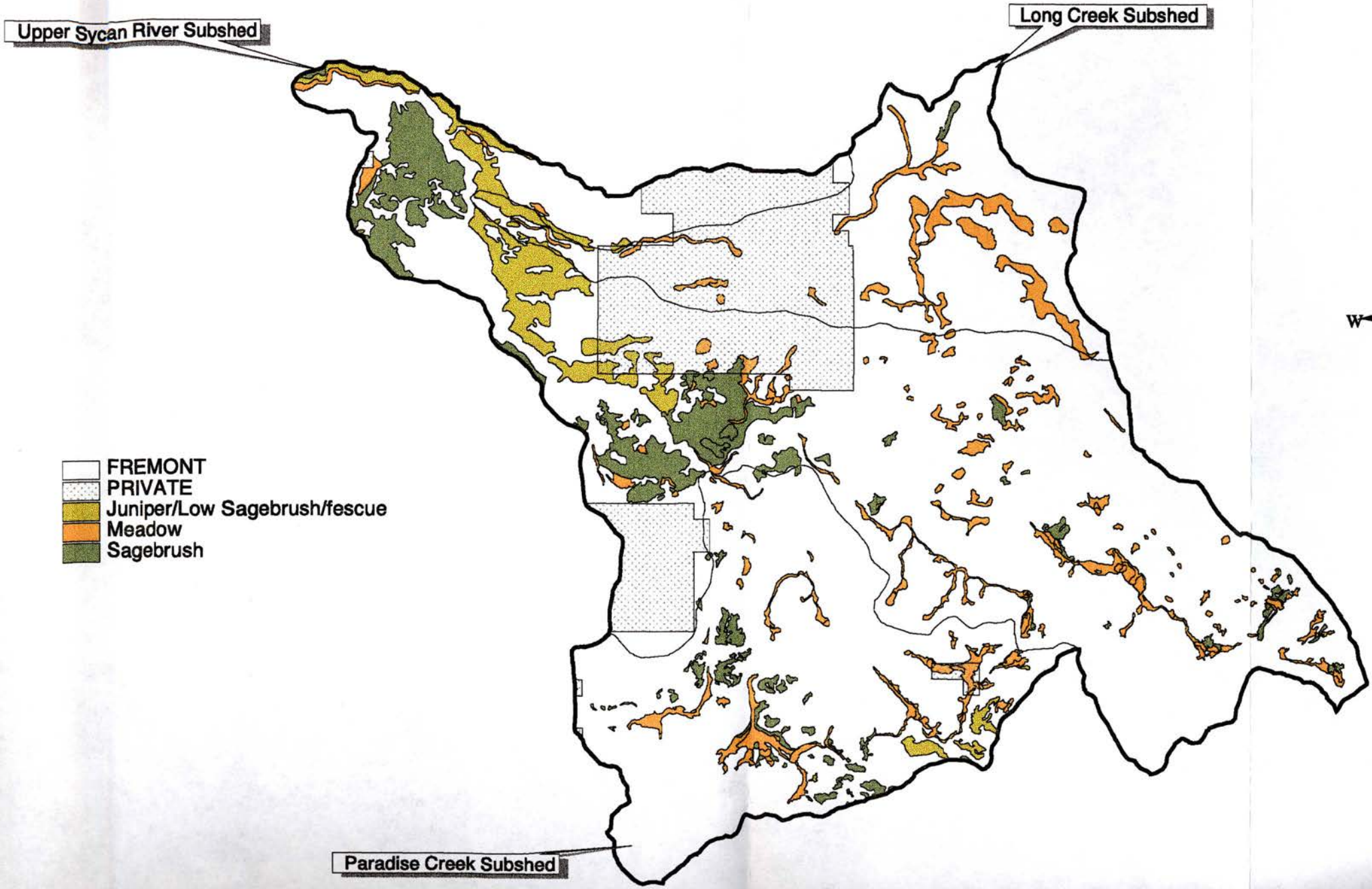
Table. 3.20a Non-Forested Upland Vegetation

Plant Association		Total Acres in Watershed
Bluegrass-Dry Meadow	MD-31-11	2,330
Hairgrass-Sedge-Moist Meadow	MM-19-11	1,300
Sedge-Wet Meadow	MW-19-11	300
Big Sagebrush/Bunchgrass	SD-29-12	500
Low Sagebrush/Fescue-Squirreltail	SD-19-13	2,500
Low Sagebrush/Bluegrass-Onespike Oatgrass	SD-92-12	1,000
Low Sagebrush-Goldenweed/Bluegrass	SD-92-11	3
Juniper/Low Sagebrush/Fescue	CJ-S1-12	2,400
Approximate Total Non-Forested Acres		10,300

Table. 3.20b Non-Forested Upland Vegetation by Ecological Seral Status.

Plant Association	Seral Stage by Percentage (%)		
	Early	Mid	Late
Bluegrass-Dry Meadow	10	80	10
Hairgrass-Sedge-Moist Meadow	<10	10	80
Sedge-Wet Meadow	<10	-	90
Big Sagebrush/Bunchgrass	<10	20	70
Low Sagebrush/Fescue-Squirreltail	<10	30	60
Low Sagebrush/Bluegrass-Onespike Oatgrass	<10	30	60
Low Sagebrush-Goldenweed/Bluegrass	<10	30	60
Juniper/Low Sagebrush/Fescue	20	40	40

Non-Forested Vegetation In Upper Sycan Watershed



1. Meadow Communities

The most common meadow community in the watershed is the **Bluegrass-Dry Meadow** type, totaling approximately 2,330 acres. Bluegrass dry meadows are scattered throughout the watershed and are an important forage component, receiving the most use of all the meadow associations. A key factor is the presence of Kentucky bluegrass, which remains palatable throughout the grazing season, with re-growth occurring with even slight moisture. Kentucky bluegrass often remains green until snow cover occurs. Kentucky bluegrass is also represented as the dominant species in dry meadows because it is well suited to withstand grazing pressure. A majority of dry meadow types in the watershed are rated in fair condition with a static trend - see *Table 5.18* on page (5-34) for condition and trend for all non-forested vegetation.

Poor condition dry meadows may be represented by higher bare ground percentages where Kentucky bluegrass grows more sparsely. Bluegrass clumps are pedestalled and higher percentages of low value forbs (mostly annuals) and grasses such as yarrow, cinquefoils, pussytoes, Baltic rush, asters and dandelion are common to these degraded sites.

Fair condition meadows in the watershed are characterized by a combination of plant species found on good and poor condition range.

Good condition Bluegrass-Dry Meadow sites also include combinations of meadow barley, California oatgrass, pullup muhly, timothy and trace amounts of sedges. Litter covers up to 50% and bare ground does not exceed 20% (Hopkins 1979).

Grazing pressure has kept most of these meadows in mid succession by somewhat mimicking the ecological role of fire by controlling litter accumulation. Dry meadows in climax condition were not found on the Fremont National Forest during the development of the plant association guide in 1979, however, a small percentage of late successional dry meadows are evident today, as Kentucky bluegrass has become a naturalized climax species. Dry meadow production ranges from 1,190-6,150 pounds/acre of herbage (Hopkins 1985).

There are approximately 1,300 acres of Hairgrass-**Sedge-Moist Meadow** in the watershed. Moist meadows can be found in mid-late succession and are generally found at elevations between 5, 400 and 6,900 feet. Moist meadows in the watershed are rated in fair condition with a downward trend since litter has accumulated and live plant cover has decreased. Most of the moist meadows in the Sycan are decadent and in need of fire to remove litter cover and stimulate new vegetative growth. The range of herbage production is from 1020-5735 lbs/acre (Hopkins 1985).

Poor condition hairgrass meadows are represented by a presence of Kentucky bluegrass, mat muhly, pullup muhly, Baltic rush and forbs. A general increase in bare ground from pocket gopher activity is common. Sites dominated by false hellebore, possibly due to lowered water tables from channel downcutting, are considered very poor condition. Silver sage invades these deteriorated sites as well.

Fair condition meadows have a species composition that is a mix of what is described for good and poor condition moist meadows. Litter tends to accumulate and vegetative cover decreases if sites are not grazed or burned periodically.

Tufted hairgrass and sedges (decreaser species) represent good condition moist meadow sites, with rushes and pull-up muhly comprising a minor component. Tufted hairgrass, Nebraska sedge and Kentucky bluegrass are the most palatable species in these meadows, which are preferred by cattle late in the season. As a result of this later season use, utilization tends to be light to moderate. During drought years, however, these meadows received much higher livestock use enabling the establishment of non-native species such as meadow foxtail into these meadows.

Sedge-wet meadow communities occupy roughly 300 acres within the watershed. These sites are generally inundated with water throughout the grazing season, which seems to deter livestock use. Average use is slight (0-5%) to light (6-20%). Sedge-wet meadows in the watershed are rated in good condition with a downward trend.

Poor condition sites are seldom seen because of their resilience to overgrazing, however, a downward trend would show an increase in Baltic rush and wetland forbs. If present, willows become highlined and decadent (Volland 1976).

Wet meadows in good condition are dominated by wetland sedges and have a relatively thick litter layer. Basal area cover is naturally low on climax condition sites.

Although they comprise only a small portion of non-forested plant communities, wet meadows provide a significant amount of forage when compared to other meadow communities. Herbage production for these sites ranges from 925-5070 lbs/acre (Hopkins 1985).

2. Shrub/Bunchgrass Communities

A majority of the sagebrush-dominated communities are in mid to late seral ecological status, primarily due to the suppression of fire. Over the last 100 years, western juniper has advanced into mountain big sagebrush and low sagebrush communities to varying degrees due to factors such as interrupted fire cycling and climatic conditions (Miller 1997). Historically, intense grazing caused a decrease in fine fuels, such as bunchgrasses, inhibiting the role of fire and thus altering the plant community structure, reducing competition from herbaceous plants and allowing sagebrush to dominate and juniper to encroach. Unregulated, season long grazing on what is now the Fremont National Forest from the late 1800's up through the early part of this century has influenced the species composition of many upland non-forested plant communities in the watershed. The result has been a reduction in perennial bunchgrass cover and an increase in shrub density. Perennial bunchgrass range has been allowed to mature into somewhat decadent sagebrush lands with a reduced grass and forb understory.

With loss of floodplain accessibility due to down cutting and lowered water tables in riparian zones, big sagebrush and silver sagebrush have often expanded into sites formerly occupied by willow/sedge communities (Kovalchik 1987). Cattle prefer the palatability and diversity of riparian vegetation and tend to use these areas more than uplands, if left untended. Grazing can affect stream temperature by removal of bank stabilizing and shade producing vegetation and by trampling or caving in overhanging stream banks, allowing an increase in solar exposure on the water surface.

The **Big sagebrush/bunchgrass** association characterizes 500 acres of the watershed. Much of this community type is in the mid to late seral stages and is represented by mountain big sagebrush at elevations above 6000 feet. Most of the sagebrush types found below this elevation are basin big sagebrush communities. Current range condition is fair with a downward trend due to shrub density increases.

Poor condition sites are dominated by big sagebrush, green and gray rabbitbrush and cheatgrass. Heavily grazed range reduces the Sandberg bluegrass component. Western juniper invades and increases in cover with continued overuse and/or lack of fire.

Good condition sites are represented by a dominant bunchgrass herbaceous cover. Antelope bitterbrush and curlleaf mountain mahogany make up a very minor component. Forbs are present in trace amounts. Western juniper is absent or less than 5% cover. Green and gray rabbitbrush may be evident, but are highly dispersed on good condition range

Very little juniper invasion can be documented in big sagebrush/bunchgrass communities through "direct hits" along permanent condition and trend transects. However, the photo points for the general area of these transects vividly show an encroachment. Range of herbage production is 85-650 lbs/per acre (Hopkins 1979).

About 2,500 acres of the watershed are characterized by **Low sagebrush/fescue-squirreltail** range. This community type is also present in a mid to late successional stage, with very little acreage in early succession. These sites are dominated by low sagebrush. Low sagebrush sites in the watershed are rated in fair range condition and upward trend. The range of herbage production is 75 to 890 lbs/per acre.

Sandberg bluegrass, squirreltail, biscuitroot, pussytoes, sandwort and rabbitbrush dominate poor condition sites. In poor sites, cheatgrass invades, annual forbs increase and decreaser plants become restricted to the protective shrub canopy.

Good condition sites are dominated by bunchgrasses such as Idaho fescue, bluebunch wheatgrass and western needlegrass.

The **Low sagebrush/bluegrass-onespike oatgrass (SD-92-12)** association occupies roughly 1,000 acres of the watershed. These sites have a shallow restrictive layer found at 12-20 inches in the soil profile, abundant protective surface rock and are found on more mesic microsites, whereas, drier sites with deeper soils support the low sagebrush/fescue-squirreltail association. As stated above, low sagebrush sites in the watershed are rated in fair range condition and upward trend. This association produces between 200-300 lbs/acre.

Poor condition sites exhibit an increased forb cover. Palatable decreaser grass species are restricted to the protection of rock crevices and shrub canopies.

Good condition sites are dominated by low sagebrush of varying age classes, Sandberg bluegrass and oatgrass with little evidence of surface soil erosion.

There are 3 acres of **Low sagebrush-goldenweed-bluegrass (SD-92-11)**. This type is characterized by low sagebrush, narrowleaf goldenweed and Sandberg bluegrass. These sites have naturally low vegetative cover and shallow rocky soils.

3. Juniper Communities

There are 2,400 acres of **Juniper/low sagebrush/fescue** lands in the Upper Sycan Watershed. Exclusion of periodic fire invites juniper expansion out of this community. Presettlement juniper woodlands were once restricted to rocky bluffs, ridges and dry shrub communities with low fire frequencies, however, expansion since the late 1800s has been into the more mesic environments where this invasive species has dramatically increased from its historic range. Encroachment has been slow into areas with prevalent low sagebrush, primarily due to soil depth limitations. Western juniper is commonly found outside of its range of natural conditions, encroaching primarily on big sagebrush/bunchgrass range and the low/drier end of ponderosa pine and aspen communities. The true Juniper/low sagebrush/fescue association is typically found in mid to late seral condition, but has expanded out of its historic range and created early-mid successional juniper stands within low and big sagebrush communities. Range condition on these sites is fair with a downward trend.

On poor condition sites, bunchgrasses are predominantly found under the protection of shrub and juniper canopies.

Good condition sites are dominated by low sage and scattered western juniper (2-4 trees/acre). Mountain mahogany is present on less rocky areas.

With burning, the forb cover increases and rabbitbrush and cheatgrass easily invade these sites. Herbage production ranges from 200-700 lbs/acre. Scattered juniper woodland is evident in the northwest portion of the watershed in scabrock flat areas and adjacent to the Sycan River corridor in the eastern portion of the watershed. Low sagebrush flats dominate this plant association. Idaho fescue is the dominant herbaceous species.

A 1997 study conducted in the eastern portion of the Chewaucan watershed of the Paisley Ranger District, shows that juniper expansion and establishment on deep soils has peaked in many areas and created closed juniper woodlands. Although the extent of juniper encroachment in the Sycan River is less extreme, it is a concern. Fire exclusion has allowed juniper establishment and/or expansion in many scab-rock flats. Studies indicate historic fire return intervals in juniper to be between 10 and 25 years, but may be considerably longer on isolated patches of juniper. Fire histories are extremely difficult to determine in sagebrush, but historical fire return intervals were probably between 10 and 50 years, depending on the site productivity. Past grazing practices may have also significantly affected the ecology of these scab-rock flats.

Lower densities of post settlement juniper are found in low sagebrush sites compared to mountain big sagebrush primarily due to soil depth parameters, as establishment and growth of juniper are somewhat restricted on the shallow rocky clay soils associated with low sage sites (Miller 1997).

4. Open Forest Communities

Several pine communities have an understory component that is capable of providing forage. **Ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue, ponderosa pine/mountain big sagebrush/bluegrass, and ponderosa pine-quaking aspen/bluegrass** associations constitute over 25,000 acres of the watershed. These ponderosa pine dominated communities show the effects of interrupted fire cycling, including an increase in seedling and shrub understory density and excessive accumulation of litter. As a result of this, perennial bunchgrasses, such as Idaho fescue, have declined as well as overall species diversity.

Aspen stands are found within all the forest types in the watershed and their fire return interval is probably related to the surrounding stands fire return intervals. Periodic disturbance stimulates sprouting and encourages mixed age and size structure. There are areas of decadent aspen found within the watershed that are not experiencing regeneration. Disturbance, either by cutting or fire, is necessary to stimulate new growth in these dying stands. Aspen may often act as a barrier to fire spread since it typically grows in more moist conditions. See the map *Aspen Stands In Upper Sycan Watershed*, following page (3-32).

Suppressed aspen stands are commonly encountered in the watershed due to the absence of fire in the ecosystem. Natural regeneration of these aspen stands has been thwarted due to fire suppression efforts. In the absence of fire, conifers have encroached into a majority of aspen stands in the watershed. Encroachment by lodgepole pine, white fir and in some cases juniper is contributing to the degradation of these groves. Past heavy livestock grazing has had a negative impact on aspen regeneration, particularly at the time when sheep were the prominent class of livestock on the range. Relatively short-lived aspens are in danger of being replaced by longer-lived conifers. Aspen provides a high protein palatable food source for wildlife such as mule deer and elk, during times of the year when other plants are unavailable for browse. The extent of current utilization of aspen by either native herbivores or cattle is unknown. Use by cattle is expected to be more intense in pastures grazed later in the season.

Noxious Weeds

There is considerable habitat for noxious weeds throughout the Upper Sycan Watershed, primarily due to ground disturbance of past management activities such as grazing, logging, and road construction. As a result, on a Forest-wide basis noxious weeds have invaded a wide range of ecosystems including riparian areas (wetlands), roadsides, campgrounds, rock pits, trails, forested and non-forested areas. These unwanted, introduced species have the potential to adversely affect species diversity, TE&S (Threatened, Endangered, and Sensitive) plant/animal species, range condition and forage production. Six species of noxious weeds have been identified within the Chewaucan watershed. Three species of noxious weeds have been identified within the Upper Sycan Watershed. These species are musk thistle, Canada thistle and spotted knapweed. See Table 3.21 for a listing of current noxious weed species identified within the watershed. Maps of these sites are available in the Fremont National Forest "*1998 Environmental Assessment for the Management of Noxious Weeds*".

Table. 3.21 Noxious Weed Sites by Subshed

Subshed	Weed	Number of Sites
Long Creek	Canada thistle	1
Paradise Creek	Canada thistle	5
	Musk thistle	8
Upper Sycan	Spotted knapweed	1
	Canada thistle	7
	Musk thistle	2

The 24 known noxious weed sites in the watershed each occupies approximately 0.1 acre. These sites are still in the incipient stage of invasion and as such are still susceptible to eradication with vigorous effort and minimal use of herbicides.

Musk thistle is a biennial plant that aggressively invades disturbed sites and can form dense stands which eventually crowd out desirable plants. This thistle is generally found in forested areas that have been logged or can be found in other areas associated with ground disturbance.

Canada thistle has the capability to remain in relatively small populations for a number of years then increase exponentially. It is an aggressive colony forming perennial that reproduces by seed and by rhizomes that enable this plant to spread rapidly over large areas. For the most part this weed is most likely to invade riparian areas and has the capability to crowd out large portions of the native riparian flora forming extensive underground rhizomes that are currently controllable only by translocated herbicides. Only the Rodeo formulation of glyphosate is currently registered for use in riparian areas. All of these species, if left unchecked, could seriously affect the goals of managing for healthy forests, rangelands and other resources on the Fremont National Forest. There are currently no noxious weed populations known to occur in occupied R-6 sensitive plant habitat on the Fremont National Forest.

Threatened, Endangered, or Sensitive Plant Species

The Upper Sycan Watershed has approximately 3,500 acres of occupied R6 sensitive plant habitat. This represents 5.3% of the watershed.

There are no populations of these R6 sensitive plants in Upper Sycan Watershed designated as protected under the Conservation Strategies in effect for these species. Green-tinged paintbrush is a southern Oregon endemic that occurs primarily as a hemiparasite on mountain big sagebrush. The middle aged mountain big sage communities have developed to the stage where green-tinged paintbrush appears to be deriving the maximum benefit of the weak mutualistic relationship. The sagebrush is susceptible to killing by fire. Where fire has occurred in the habitat it appears to take at least 10 to 20 years for Castilleja to return to the brush.

No threatened or endangered plant species have been identified within the watershed.

Table. 3.22 Occupied Sensitive Plant Habitat in the Upper Sycan Watershed

Common Name	Scientific Name	Occupied Habitat
Green-tinged Paintbrush	*Castilleja chlorotica*	3,150 Acres
Blue-leaved Penstemon	*Penstemon glaucinus*	350 Acres

III. Terrestrial Species and Habitat

Key Questions:

1. How have wildlife abundance, distribution, diversity and habitat conditions been altered?

2. What key terrestrial habitat components are scarcest or most at risk? What threatens species viability?

3. Where are the known problem areas that are contributing to reduced wildlife habitat capability?

Threatened, Endangered, and Sensitive Species

1. Northern Bald Eagle (Threatened, Proposed for De-listing)

There are no known active nest or roost sites identified on National Forest System lands within the watershed. Isaacs and Silovsky (1991) characterized potential eagle nesting and roosting areas for the Fremont National Forest and identified a portion of the Upper Sycan River subshed as potential habitat (P15, Sycan Marsh, Southeast). This area encompasses approximately 390 acres where the Sycan River enters the Sycan Marsh area, in T.32S., R.14E., Sections 22 & 27. Additional potential habitat exists where large, open-branched ponderosa pine are present near open water foraging habitat,

primarily along the Sycan River. The nearest known active site is the Sycan Marsh nest and Bald Eagle Management Area located adjacent to the northwestern boundary of the watershed.

2. American Peregrine Falcon (R-6 Regional Forester's Sensitive Species List; recently De-listed from Endangered)

Potential peregrine nesting habitat has been identified at one cliff site within the Upper Sycan subshed of the watershed (White, et al, 1980). Five additional sites have been identified on or immediately adjacent to the watershed boundaries along Winter Ridge. Only sporadic surveys of these potential sites have occurred. It is not known if any of these sites are occupied. None of these sites have been allocated to Management Area 2 (Endangered and Threatened species emphasis). There are no known active or historical nest sites.

3. California Bighorn Sheep (R-6 Regional Forester's Sensitive Species List)

Several bighorn sheep reintroductions since 1982 have established populations in two areas near the Upper Sycan Watershed. These include reintroductions to the east of the watershed (Hadley Butte - 1982 and Mill Creek – 1995) and to the north of the watershed (north Winter Ridge – 1982 and 1992). Undoubtedly there is movement between these populations, some of which may occur within the watershed, primarily along Winter Ridge. However, no occurrences of bighorn sheep have been documented within the watershed. The nearest documented sightings have been at Monument Rock, approximately 3 miles east of the watershed boundary.

Isolated patches of bighorn sheep habitat occur along the Sycan River within the Upper Sycan River subshed. However, since bighorn sheep generally avoid forest zones, it is doubtful that these patches would be utilized.

4. Greater Sandhill Crane (R-6 Regional Forester's Sensitive Species List)

Four sandhill crane nest sites have been documented in the Upper Sycan Watershed. Three, one at the Sycan River and two near Louse Lake, are in the Upper Sycan subshed. The fourth is at Watson Creek, in the Paradise Creek subshed. Although 300 acres of wet meadow, 1,300 acres of moist meadow, and 2,330 acres of dry meadow are mapped within the watershed, it appears that much of this habitat is used only as foraging habitat by sandhill cranes. Moist/wet meadows are commonly used as nest sites.

5. Western Sage Grouse

Sagebrush habitat for western sage grouse is minimal within the watershed. Only about 500 acres of non-contiguous big sagebrush habitat have been identified. All of this is isolated from the expansive tracts of relatively good sage grouse habitat in the Summer Lake basin and beyond. It is doubtful that the sagebrush patches have any value as sage grouse habitat. There are no known historic or currently occupied areas of western sage grouse habitat within the watershed.

Keystone Species and Other Terrestrial Species

1. Big Game

The Upper Sycan Watershed includes portions of the ODF&W Interstate and Silver Lake Management Units for deer and elk and of the ODF&W South-Central Elk Management Zone. Portions of the range of the Interstate and Silver Lake deer herds and of the North Interstate and Winter Ridge elk herds occur within the watershed.

The watershed includes approximately 65,500 acres of summer range and 240 acres of transition range for the Interstate and Silver Lake mule deer herds. It also includes both winter and summer range for the North Interstate and Winter Ridge elk

herds. The Oregon Department of Fish and Wildlife management objective for the Interstate and Silver Lake mule deer herds is 14,800 and 10,300 wintering deer, respectively. Wintering deer in 1998/1999 were estimated at 35% (Interstate) and 85% (Silver Lake) of management objective. Although Interstate herd count numbers are low, this is thought to be due to poor weather conditions during the count (Hedrick, pers. comm). In general, the mule deer population appears to be on a slight upward trend.

Management objective for the South-Central Elk Management Zone is 3,000 animals. The current number of elk in the management zone is not known, however elk numbers appear to be increasing at a steady rate and are thought to be approaching management objectives.

The Upper Sycan Watershed provides fair habitat for mule deer and other large ungulate species. Cover, both hiding and thermal, though plentiful is generally poorly distributed throughout the watershed. For this analysis, big game cover was estimated by aerial photo interpretation (1988 aerial photos and 1994 ortho quad maps) and then re-mapped following confirmation with ground surveys. The cover /forage ratio within the watershed is 50.6 cover / 49.4 forage, well above the 30% minimum for cover required by the Fremont LRMP. A 40/60 to 50/50 cover to forage ratio is considered optimal (Thomas 1979). Analysis of mule deer habitat was performed by using habitat effectiveness (HE) calculations. Habitat effectiveness analysis is based on the principle that the most well-used and effective habitat, in relation to the juxtaposition of cover and forage, is within 600 feet of an edge of cover. Cover and forage habitat are mapped and acres are measured to calculate the percent of the planning area that is *effective* from the standpoint of cover/forage juxtaposition. Mapping and calculations are modified to reflect actual use patterns that may deviate from the "600 foot rule". Modifiers to this percent, including road density, water availability, forage utilization by domestic livestock, and cover/forage ratio, based on the principles of the South Central Interagency Mule Deer model, are used to arrive at a final HE value. The HE value for the entire watershed is 51.8%. The Fremont LRMP standard and guideline is 50% minimum HE on summer range. Factors of greatest influence on HE, in order of highest effect, include cover distribution, forage utilization by domestic livestock, and road densities. The cover to forage ratio and percent HE for each subshed are shown below.

Table. 3.23 Current Mule Deer Habitat Effectiveness in the Upper Sycan Watershed

Subshed	Cover / Forage Ratio	Habitat Effectiveness (% HE)
Long Creek	45.9 / 54.1	47.4
Paradise Creek	66.1 / 33.9	58.8
Upper Sycan River	45.6 / 54.4	59.5
Entire Watershed	50.6 / 49.4	51.8

Somewhat greater than 8,000 acres of the watershed are considered non-forested habitat and may not be able to produce significant amounts of cover. Cover utilized in these areas may not meet current Fremont LRMP definitions, but may still function as big game cover.

All seasonal habitats are in a state of advanced plant succession and thus have a reduced capacity to support big game. Forage availability in LOS stands has declined as density and structure within these stands has increased. An increase in the density and distribution of juniper at lower elevations has reduced the productivity of herbaceous and woody forage, but has increased cover. Riparian habitat conditions for fawning, calving and rearing have been degraded since the turn of the century by heavy livestock and ungulate grazing. Road densities on National Forest lands exceed the minimum desired condition for habitat security (2.5 miles of road per square mile) in all subsheds except Upper Sycan River. Road densities by subshed are listed below.

Table. 3.24 Current Open Road Density in the Upper Sycan Watershed

Subshed	Road Density on National Forest Lands (Mi/Sq. Mi.)	Road Density including Private Lands (Mi/Sq. Mi)
Long Creek	2.76	3.04
Paradise Creek	2.94	2.95
Upper Sycan River	2.49	2.61
Entire Watershed		2.76

Logging activity from the 1950's through the 1990's has created openings and increased edge habitat in the forest landscape, improving overall foraging conditions on summer ranges. Hiding and thermal cover has decreased and motorized access to summer ranges has increased. Deer numbers during this period fluctuated greatly. Population indices, calculated to 5-year averages, peaked in the early 1960's and reached their lowest levels in the early 1980's. The Interstate and Silver Lake deer populations peaked in the 1950's and have since declined by 60%. The population has been relatively stable in the last 20 years and appears to be within the carrying capacities of seasonal ranges.

Elk are distributed and suitable elk habitat occurs throughout the watershed. Winter range for both the North Interstate and Winter Ridge elk herds has been identified within the Upper Sycan and Paradise Creek subsheds. Calving areas, generally associated with riparian, meadow, and/or moist soil sites, have been identified in the Paradise Creek subshed in the Paradise and Watson Creek drainages (Foster, 1994). Additional, less consistently used calving habitat undoubtedly exists in suitable sites throughout the watershed. Migration corridors for elk are primarily between summer range and winter ranges to the north and west. Winter range occurs to the west and north near Sycan Marsh, Thompson Reservoir and Silver Lake. The elk population in the South-Central Management Zone, estimated at 1,300 animals, was steadily increasing as of 1997. The population is expected to continue growing and expanding into unoccupied habitat until it reaches equilibrium with the habitat's carrying capacity. It is expected that the population management objective (2,000 elk) will be attained by 2010 (Hershey, 1997)

2. Beaver

No formal surveys to determine beaver presence have occurred within the watershed. There is no documented evidence of active beaver colonies within the watershed. No distinction between historic and current activity has been made for existing beaver sign within the watershed. However, evidence of beaver activity is present in all three subsheds and anecdotal information indicates beaver presence within all subsheds.

Historically, beaver colonies existed within all three subsheds with the highest concentrations in the Upper Sycan subshed. Current activity has been noted in this subshed, however colony locations have not been determined. Colony locations on the Sycan River may be difficult to determine as only bank denning sites have been observed, rather than the traditional damming and lodge building activities normally associated with beaver presence.

Potential habitat occurs in riparian areas with deciduous vegetation. Current population numbers and distribution are likely lower than they were before the onset of trapping and intensive lands management activities. Potential habitat is also probably lower than historic levels as declines in deciduous and herbaceous vegetation associated with grazing and fire exclusion have combined to create less than optimal conditions. Still, a considerable amount of unoccupied potential habitat exists within the watershed.

3. Other Terrestrial Species

Other terrestrial animals common to the high desert and east Cascades are found in the area. Bobcats, coyotes, rabbits, porcupines, red-tail hawks, golden eagles, prairie falcons, ravens, kestrels, great gray and great-horned owls, amphibians, reptiles, neotropical birds, primary and secondary cavity nesters, and numerous other raptors, birds, and small mammals are present within the watershed.

Point count surveys on the Sycan River have documented Neotropical migrant and other bird species presence in riparian habitats since 1994. Sixty-four species of birds were documented during this period. No other surveys except management indicator and TES species surveys have been conducted within the watershed.

Management Indicator Species Associated with Late and Old (LOS) Forest Cover

1. General

Late seral forest cover has not been mapped within the Upper Sycan watershed. This represents a data gap for this analysis. Old growth forest cover has been mapped. An assumption of this analysis is that the known changes in old growth forest

cover provide an accurate indication of changes that have occurred in late seral forest cover.

LOS forest cover has declined since 1950, and species composition has changed in pure ponderosa pine to a more mixed conifer forest. Little LOS ponderosa pine remains as single story stands. LOS cover in lodgepole pine stands has increased from virtually nothing in 1946/47 to 14% old growth and an undetermined amount of late seral forest cover today. In general, habitat for species associated with open, parklike single canopy LOS ponderosa pine stands has declined while multi-storied more mixed conifer and lodgepole pine LOS habitat has increased. LOS habitat increases however have been somewhat negated by reduced continuity within a landscape fragmented by early and mid-seral patches.

Allocated old growth forest habitat (Management Area 14) occurs on approximately 3,280 acres, or 6% of National Forest lands within the watershed. Another 2,680 acres are classified as old-growth, but are not allocated for old growth management in the LRMP (these areas – in combination - are show in Step 3 on the map *Old Growth and Connectivity in the Upper Sycan Watershed*, following page (3-15). Large diameter live trees, snags and down wood are conspicuously absent from large areas of the landscape and greatly reduced in abundance and distribution in other areas. Overstocked understories in many stands are contributing to overstory mortality of large trees and a decline of late/old seral forest characteristics. Patches of early and mid-seral stands now fragment the forest landscape.

Table. 3.25 Old Growth Acres

Subshed	MA 14 Old Growth (acres)	"Other" Old Growth (acres)
Long Creek	380	190
Paradise Creek	1,100	650
Upper Sycan River	1,800	1,840
Watershed Totals	3,280	2,680

Average and maximum patch sizes of late/old seral forest have been reduced. Many patches that historically functioned as interior habitat now function as ecotone (edge) habitat and late/old forest cover is now strongly influenced by edge effects due to habitat fragmentation. At a finer spatial resolution, an average road density of 2.76 mi/mi2 has added to the increase in edge and reduction of interior habitat. Road densities on National Forest lands exceed 2.5 mi/mi2 in two of the three subsheds (see Table 3.24).

2. Northern Goshawk

There are approximately 2,900 acres of suitable old growth habitat for northern goshawk within the watershed. Of these, approximately 900 acres have been dedicated as old growth habitat (MA 3 and 14) for northern goshawk. Twenty goshawk nest sites and eleven territories have been identified within the watershed. Seven territories have been active during the past five years. Post-fledging family areas (PFA's) and nest stands totaling approximately 4,670 and 390 acres, respectively, have been delineated within the watershed (see Table 3.26, below, and the map *Goshawk Territories in the Upper Sycan Watershed*, following page (3-31).

Table. 3.26 Northern Goshawk PFA's and Nest Stands

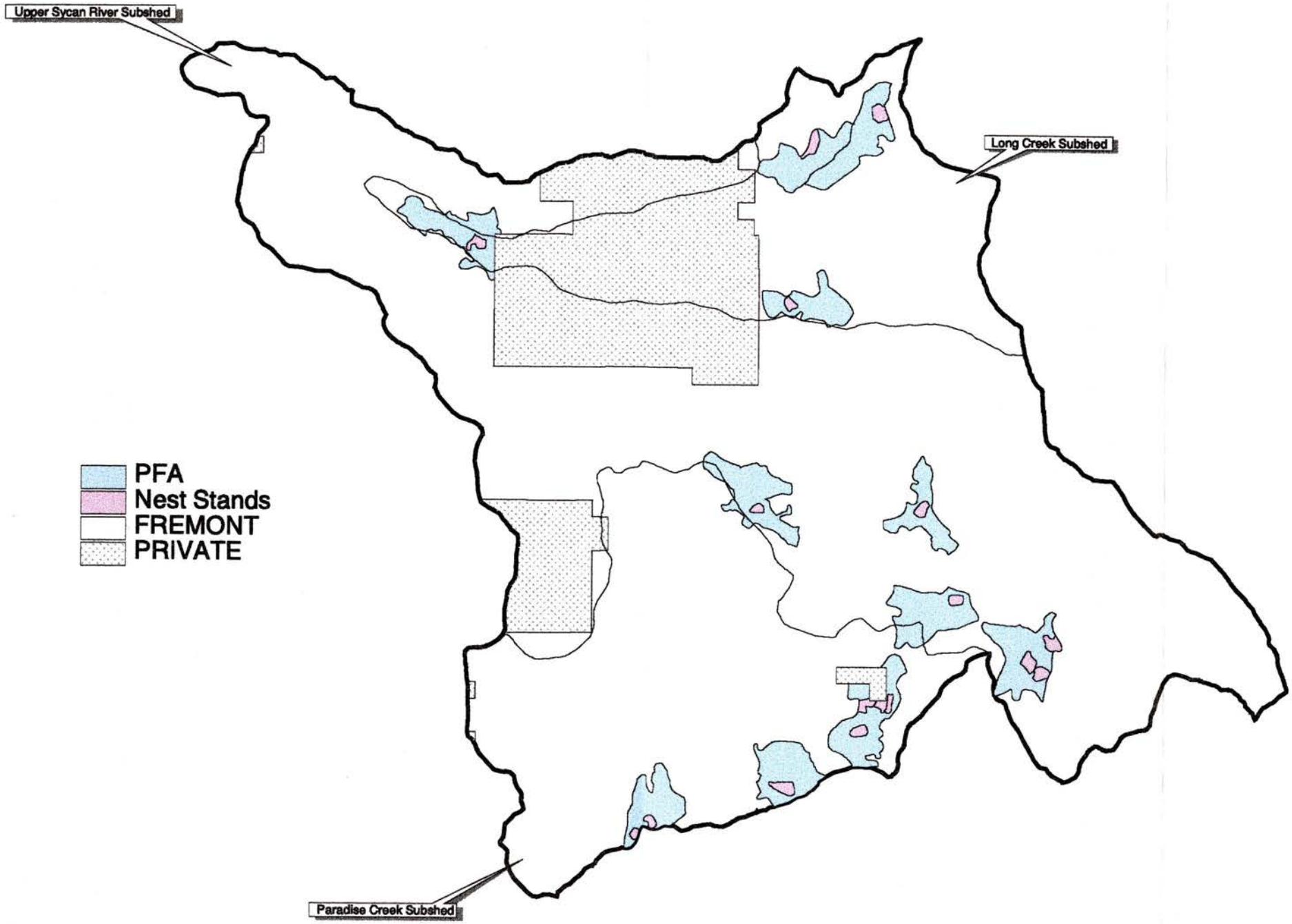
Subshed	PFA Acres	Nest Stand Acres
Long Creek	1,460	110
Paradise Creek	1,390	140
Upper Sycan River	1,820	140
Watershed totals	4,670	390

Suitable habitat for goshawks currently exists in all subsheds.

3. Pileated Woodpecker

Approximately 1,650 acres old growth are available as suitable habitat for pileated woodpecker. Of these acres, 760 have been dedicated as old growth habitat (management areas 3 & 14) for pileated woodpecker.

Goshawk Territories In Upper Sycan Watershed



Pileated sightings, vocalizations, and foraging habitat have been recorded in the Paradise Creek and Upper Sycan River subsheds. None of the watershed has been surveyed for presence of pileated woodpecker. Areas of suitable habitat occur primarily in mixed conifer stands in the upper elevations of the Paradise Creek and Upper Sycan subsheds. Suitability decreases within the mid to lower elevations of the watershed where ponderosa pine dominates.

4. American Marten

Approximately 4,000 acres old growth are available as suitable habitat for marten. Of these acres, 2,000 have been dedicated as old growth habitat (management areas 3 & 14) for marten. Potential habitat exists in all subsheds. The only documented report of marten within the watershed is near Watson Creek in the Paradise Creek subshed (1999). This is an unconfirmed sighting with no determination of observer reliability.

5. Black-backed/Three-toed Woodpecker

Approximately 2,900 acres lodgepole pine old growth are available as the most suitable habitat for black-backed woodpeckers. Of these acres, 2,150 have been dedicated as old growth habitat (management areas 3 & 14) for three-toed woodpecker. Another 2,150 acres of younger seral lodgepole are designated for future potential habitat and will be managed as replacement old growth habitat for three-toed woodpecker. Several thousand acres of late seral lodgepole pine and less preferred, though suitable, LOS pine or fir stands containing scattered or patchy lodgepole pine, are also available as habitat.

All subsheds have potential habitat for black-backed woodpeckers.

Foraging activity may have increased across the watershed in association with increased bark beetle activity in recent years. Overstory mortality occurring in large diameter pine and fir in recent years from drought, overstocked stands, and an increase in disease and insect activity have created additional snag habitat to improve nesting habitat conditions and prey availability. Sanitation and salvage logging, however, has limited the availability and abundance of this habitat. Availability, continuity, and suitability of habitat in ponderosa pine and mixed conifer habitats and continuity in lodgepole pine habitats have declined over the past 50 years, while availability and suitability have increased in lodgepole pine habitats with increases in LOS forest cover.

Dead Wood Habitat Management Indicator Species (MIS)

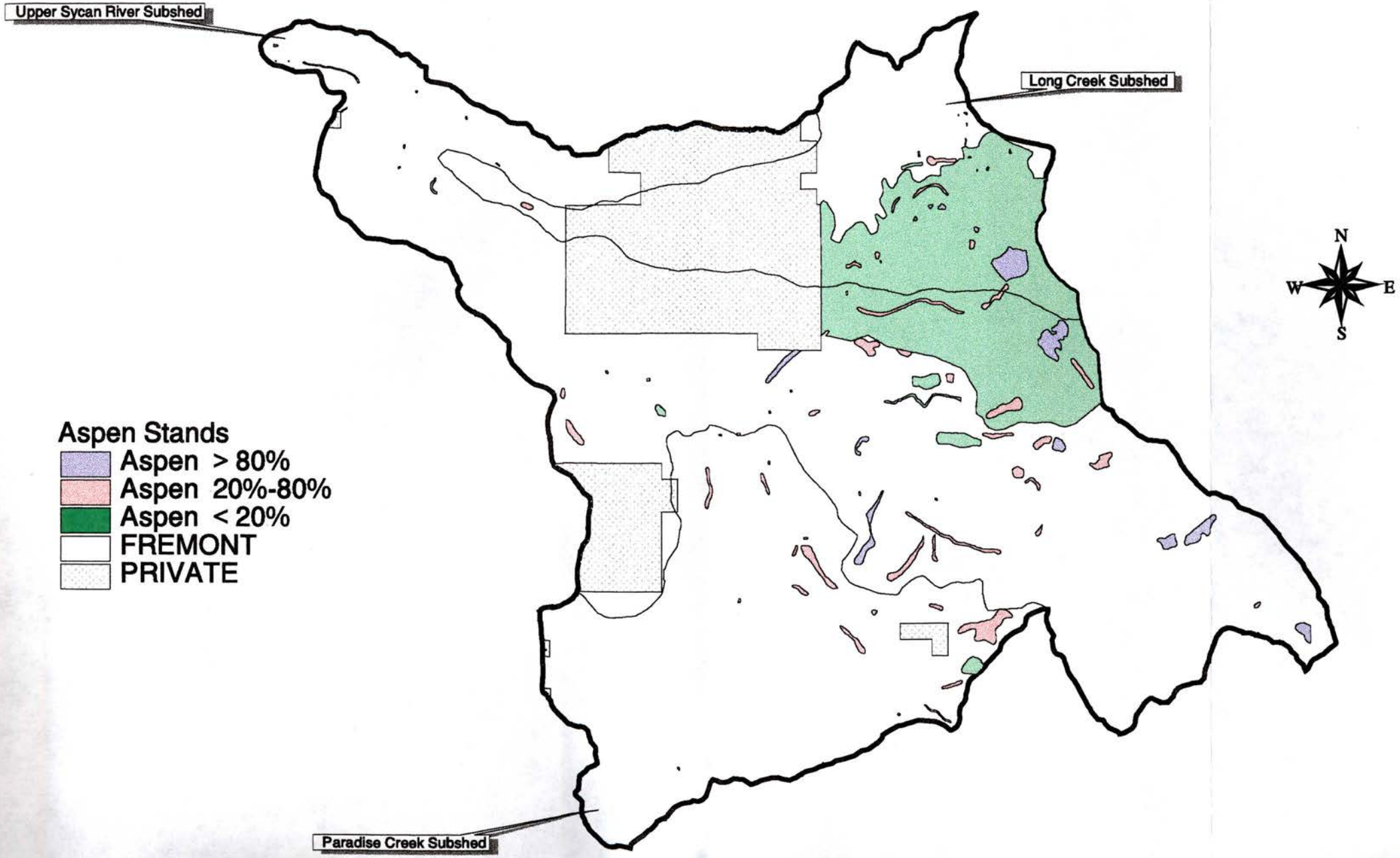
1. Primary Excavators

Cavity dependent species that may be present in the Upper Sycan watershed include Lewis' woodpecker, northern flicker, black-backed woodpecker, hairy woodpecker, downy woodpecker, white-headed woodpecker, Williamson's sapsucker, red-breasted sapsucker, mountain chickadee and the red-breasted, white-breasted and pygmy nuthatches.

Snag and large down wood (also referred to as "LWD" – large woody debris) densities for the forested portion of the analysis area are variable with higher numbers in areas of light or little management activities and relatively low numbers in areas of intensive management. This is the result of several factors including salvage activities, past fire prevention activities, and an inadequate number retained or loss of snags and replacements in previously harvested units. Insect and disease activity, drought, and overstory mortality due to high stand densities have resulted in new snags and down wood that exceeds those required by LRMP S&G's. However, large diameter snags and down logs are generally absent.

Snag and down wood surveys based on proposed regional protocols were conducted in the watershed during the 1998 and 1999 field seasons within stands and previously harvested units of all species. The mean number of snags and LWD for the watershed in all stands is 4.93 snags and 12.75 logs per acre. In harvested units, the mean numbers are 0.3 snags and 5.1 logs per acre. Snag and LWD data *by subshed* is available in the wildlife biology files for this analysis, however, due to sample size, statistically meaningful data could not be presented on a subshed by subshed basis.

Aspen Stands In Upper Sycan Watershed



Snag and down log densities are variable across the watershed with most National Forest lands in the watershed generally exceeding wildlife habitat needs, except snag numbers in ponderosa pine stands and harvest units.

Aspen/Deciduous Riparian Habitat MIS

1. Red-naped Sapsucker

Late and old aspen clones, the preferred habitat of both red-naped and Williamson's sapsuckers, are distributed throughout the watershed. Approximately 8,700 acres of aspen habitat have been identified – see the map *Aspen Stands In Upper Sycan Watershed*, following page (3-32). The majority of the habitat (8,400 acres) is located in the Long Creek and Upper Sycan subsheds. Aspen habitats have been characterized by the amount of aspen in the stand overstory (see Table. 3.27 below).

Table. 3.27 Aspen by Subshed and Aspen Overstory Density

Subshed	Aspen Acres		
	0 to 20% (*Scattered Aspen*)	21-80% (*Mixed Aspen*)	Greater than 80% (*Aspen Dominated*)
Long Creek	3,840	75	140
Paradise Creek	40	250	0
Upper Sycan River	3,570	425	350
Watershed totals	7,660	540	490

Many clones are in a mature, declining to overmature, or decadent condition with little regeneration evident. The limited regeneration displays light to severe damage from cattle grazing and/or ungulate browsing. Many clones are being overtopped and outcompeted by conifers, further contributing to the decline of the stand.

IV. Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

Timber

Up until World War II, the harvesting of timber and the building of roads to access the saw logs was limited to a small scale and was most dependent on local markets and somewhat dependent on the regional economics and building material needs.

The Upper Sycan Watershed is probably one of the most distant and isolated areas from sawmill, roads and markets and it is because of this that logging and road building didn't occur until much later in the current period as compared to other locations on the Forest. As the large mature trees were harvested, the Forest timber management program gradually extended roads and harvest activities in the Upper Sycan Watershed area. Timber harvesting and road building accelerated after the end of World War II with the sole purpose of removing the large ponderosa pine trees.

During this period there was an active mill in Paisley, Oregon, and several large limber mills in and around the Lakeview area.

Boards milled from ponderosa pine were a coveted material for non-structural construction. Their fine white to blonde color was attractive in window frames, doors and furniture. Most of the large pine logs that went to mills in Lakeview and Klamath Falls ended up as boxes for carrying and storing fruit and vegetables in the California markets.

Beginning in the early part of the 1990's, changing management direction within the Forest Service, both regional and nationwide, significantly reduced the amount of timber harvested within the watershed.

Additional discussion of recent timber management, by forest type, is included in Step 3 on pages (3-17), (3-19) and (3-21).

Grazing

Six allotments are located within the watershed boundary, if only partially: Currier Camp (all but one early season pasture), Bear-Lakes (small portion of West Bear pasture), Paradise Creek (northern portion of allotment) Sycan (southern half of the allotment), Riverbeds (eastern portion adjacent to Sycan River) and Wither's Special Use allotment. Currier Camp, and the Bear-Lakes allotments are grazed using a three pasture deferred rotation system. Paradise Creek allotment has an early season riparian pasture and two pastures that are used in a deferred rotation system. Use in the Sycan allotment is deferred through riding. Cattle are kept in the lower elevation country in the spring and then driven towards Winter Rim to utilize the vegetation as it matures later in the season. Riverbeds allotment does not occupy much of the Upper Sycan watershed and is grazed season long as it has minimal riparian concerns. Wither's Special Use is a deferred use two pasture allotment.

Livestock grazing on the public lands contributes to the economic viability and stability of local communities in the Summer Lake basin. It supports a lifestyle that many people feel is important to maintain and support.

Conversion of sheep allotments to cattle took place at the beginning of the current period. The last sheep allotment was converted in 1974 (John Withers, Riverbeds Allotment). In the earlier part of the current period the allotments were changed from one large allotment called Sycan common use allotment, which ran cattle, sheep, horses and swine, to the above mentioned allotments.

Recreation

Today the majority of recreational use centers on the traditional themes of fishing, hunting, and camping, but improved access, facilities, and technologies have brought more picnicking, hiking, kayaking, and float-tubing into the mix. Changing tastes in hobbies have also brought steadily increasing numbers of birders, rock hounds, wild flower viewers, and photographers into the area. Some recreational users find the Upper Sycan area appealing due to it's isolated nature and the solitude it offers.

Camping occurs within rustic forest camps (Rock Creek, Pike's Crossing). Dispersed camping is done in the general forest areas. Hiking, horseback riding, mountain bike riding takes place along the Hanan/Sycan trail. Developed camping (cabin rental) is available at the Currier cabin June 1 through November 15.

The upper Sycan River is designated as Wild and Scenic. The stream is free flowing and has high recreational fisheries values.

Cultural Plants and Subsistence Hunting and Fishing

Plants in the watershed have been used and continue to be used by the Klamath Tribes. References are made by Isabel Kelley (1932) concerning plants associated with the ecosystems found in the Upper Sycan Watershed area. Verification of this information by a Lakeview Bureau of Land Management botanist has been completed. Plants of note that were used for food, medicine, ceremonies and craft materials were ipos or epos, mountain mahogany, juniper, currant, choke-cherry,

service berry, elder berry, wild plum and rose hips.

Resources of native food plants appear to be in good condition within the watershed boundaries.

Subsistence hunting and fishing within the watershed are important activities for the members of the Klamath Tribes. Tribal members have traditionally used the area for subsistence hunting of mule deer. Providing habitat to maintain current mule deer populations is important in preserving this integral part of their culture.

Archaeology

The area contains a number of archaeology sites. These include lithic scatters, occupation sites, stone tool material quarries, vision quest sites and other American Indian religious sites. Historical sites include debris from logging activity, road building, sheep camps and recreational hunting camps. Historical livestock grazing near springs has impacted some pre-historic lithic scatters in the area, though no impact on more significant sites is known. Some sites are being impacted by the activities of artifact collectors.

Administration

Forest Service guard stations located within the watershed are Currier Cabin and Skull Creek. Currier Cabin has since been converted to a recreation rental. Skull Creek was dismantled during the 1970s' and was not replaced. Forest Service management is now accomplished out of the Paisley Ranger District office in the town of Paisley.

STEP 4. REFERENCE CONDITIONS

The purpose of Step 4 is to describe ecological conditions prior to change over time as a result of human influence and natural disturbance. Such conditions are termed "reference" conditions. Establishing reference conditions allows the comparison between reference and current conditions to be presented in Step 5 "Synthesis and Interpretation". The Reference Conditions step is presented with the premise that ecosystems adapted over extended time periods and that the greatest probability for maintaining future sustainability will require management practices which mimic or borrow from natural components, processes and structures.

I. Watershed and Aquatics

Historical conditions for hydrologic parameters are generally not available. Instead, the Watershed and Aquatics section of this document focuses on "desired condition".

Desired conditions provide a target for private and public land managers to aim for as they conduct resource management activities across the landscape. In addressing the four key questions pertaining to watershed and aquatics, numerous individuals and representatives from natural resource agencies and institutions were contacted for advice and technical expertise about desired watershed conditions. These include: Oregon State University, Oregon Department of Fish and Wildlife, Oregon Department of Forestry, Oregon Department of Agriculture, Oregon Department of Environmental Quality, Izaak Walton League, USDA Natural Resources Conservation Service, USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, the National Riparian Team (NRT) and others.

Most of the discussion was focused on the terminology used to describe the ecological status of riparian areas, such as PFC (Proper Functioning Condition) and PNC (Potential Natural Community). Proper Functioning Condition, as described by the NRT and defined in "Riparian Area Management: Process for Assessing Proper Functioning Condition" (USDI 1995, PFC manual), is described as *meeting the minimum conditions for a riparian area to function properly*. "Riparian areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and groundwater recharge; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity." The NRT and PFC manual also discussed Potential Natural Community (PNC) --"the highest ecological status an area can attain given no political, social, or economical constraints" (USDI 1995). Realizing that PFC is not the end point in stream evolution, but near the mid-point along the continuum towards PNC, the desire is to have all streams and riparian areas first meet minimum conditions, then strive to get as close to PNC as is attainable under multiple-use management. This concept would involve managing the watershed in a manner which is in harmony with the ecological processes of the area, thus resulting in enhanced water quality, fish habitat, and forage for livestock and wildlife.

In order to prevent confusion and provide consistency when describing other elements within the watershed, terminology was chosen that was cooperatively designed by the US Forest Service and the US Fish and Wildlife Service. This terminology relates to PFC and PNC in the following ways. When a parameter is in its desired condition, it is considered to be Functioning Appropriately, highly similar to PNC. When a parameter is in a functional condition, but has an existing attribute that makes it susceptible to degradation, it is determined to be Functioning Appropriately but-at-Risk. A Functioning Inappropriately rating is given when a parameter is considerably less than its desired state or does not exhibit conditions of sustainability. The overall goal is to manage for conditions that are Functioning Appropriately.

Based on the numerous discussions, desired conditions were developed for (A.) Uplands, (B.) Riparian Vegetation and Stream Channel and (C.) Habitat for Aquatic species in relation to the key questions first presented in Step 2.

Uplands

Key Question 1: Is the upland portion of the subwatershed/watershed producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas?

Parameters: 1. Desired upland plant communities
2. Desired road density, location, and drainage network

1. Upland Plant Communities and their Effect on the Amount of Water and Sediment Reaching Riparian Areas

Of the upland plant communities, the primary focus is conifers as they influence the amount of precipitation available for subsurface flow into riparian areas particularly during the summer months--the period of low flows. In such an arid environment, water becomes scarce during this time so low flows become important for maintaining riparian and aquatic habitat, water for irrigation, wildlife, and livestock. Low precipitation, reduced drainage from soil and bedrock, and sustained high evapotranspiration are factors affecting the amount of available water.

Upland conifers evapotranspirate incoming rain and snowfall--that is, they evaporate the precipitation that is intercepted on stems and leaves and transpire water that is absorbed through the roots. The precipitation, which is not evapotranspirated, becomes water yield available to ground water reserves, streams, and lakes. Bassman (1985 and 1988) provided information on the water use of ponderosa pine, mixed conifer, and lodgepole pine, which are the major forest types in the Upper Sycan River Watershed. Data referring to juniper was acquired from Bedell et al. (1993). These are listed below along with water yields--the water left over which is absorbed into the soil and available for grasses, shrubs, and subsurface flow. Refer to Table 4.1.

Table 4.1 - Conifer Species and Associated Water Yield.

Conifer Species	Annual Precipitation	Evapotranspiration Rate	Estimated Water Yield	% of Annual Precip. Resulting in Water Yield
Juniper	11-18" (14.5" ave.)	12"	2.5"	17%
Ponderosa Pine	18-30" (24" ave.)	16"	8"	33%
Mixed Conifer	20-35" (27.5" ave.)	17"	10.5"	38%
Lodgepole Pine	25-35" (30" ave.)	17"	13"	43%

Although juniper plant communities occupy only a small percentage of the watershed, juniper trees are slowly encroaching into the drier pine sites. This is a concern, since juniper trees are able to use water in the early spring before other plants begin to grow. Throughout the summer, it will continue to draw water when ponderosa pine shut their stomata and discontinue water use. A tree 18 inches in diameter at its base can transpire 30 to 40 gallons per day if adequate soil moisture is available during the summer. Because juniper has the ability to use such a large amount of water, it reduces available of water for nearby plants. This lowers shrub and grass density, soil cover, and infiltration rates. It also increases nutrient loss, overland flow, and soil erosion, often resulting in a reduction of site productivity (Bedell et al. 1993).

For all of the above reasons, an increase in conifer densities results in a loss of water available for stream flow during the dry summer months. To determine the conifer densities under which the Upper Sycan River Watershed streams evolved, Fremont National Forest silviculturists described a range of presettlement canopy closures--or the Historic Range of Variability (HRV) for various forest types. These include the following: ponderosa pine, 11-40%; mixed conifer (ponderosa pine and white fir), 26-55%; lodgepole pine and white fir, 41-70%.

In addition, the non-forest plant communities described in the uplands include the following:

- Bluegrass-Dry Meadow
- Hairgrass-Sedge-Moist Meadow
- Sedge-Wet Meadow

- Big Sagebrush/Bunchgrass
- Juniper/Low Sagebrush/Fescue
- Low Sagebrush/Fescue-Squirreltail
- Low Sagebrush/Bluegrass-Onespike Oatgrass
- Ponderosa Pine/Bitterbrush/Fescue
- Ponderosa Pine-Juniper/Mountain Mahogany-Bitterbrush-Big Sagebrush/Fescue
- Ponderosa Pine-Quaking Aspen/Bluegrass
- Ponderosa Pine/Mountain Big Sagebrush/Bluegrass (Hopkins 1979).

Of particular interest are the three meadow types because they are water storage sites, tucked away in the bottom of almost every small basin throughout the watershed and are the sources of many headwater streams. Tree densities in the surrounding catchment area influence the amount of water collected and stored in these meadows.

Fire in the uplands is essential in maintaining desired upland vegetation. The integrity of the above vegetation types (HRV forest types) and associated flow regimes are dependent on historic low intensity fires. These low intensity fires promote ecosystem stability because fuel levels are kept at a minimum, reducing the possibility of a catastrophic fire (Agee 1990). For pure ponderosa pine sites in a nearby watershed, the Upper Chewaucan Watershed, a fire return interval of 11 years was documented (Miller 1997). Mixed conifer sites, characterized by ponderosa pine and white fir, had fire intervals up to 30 years (Agee 1990). These frequent and low intensity ground fires maintained vast stands of open ponderosa pine forests, leaving a fuel gap between the overstory and ground. In the Upper Sycan River Watershed, it is estimated that these historical fire intervals maintained about 70-95% of the forested stands in a late-seral condition (mature and old), with roughly 5-15% being in a mid-seral condition (young and mid-aged), and the remaining 5-15% in openings and early seral condition.

When natural fire regimes are excluded and canopy cover increases, forested communities become susceptible to catastrophic fire. The removal of large areas of conifer by wildfire or timber harvesting has the potential to increase the amount of runoff and change the stream flow regime. Research has shown detectable changes in stream flow when 20 to 30% of a watershed is in a cutover (early-seral) condition (Troendle and Leaf 1982). For this analysis, forested lands in a cutover condition are those areas in openings--mainly as seedling/sapling stands. Further, when high intensity fires consume vegetation and forest ground cover, erosion increases (McNabb and Swanson 1990). Mass erosion into streams after a wildfire can overwhelm the channel with more sediment than local stream flows are able to transport and deposit onto floodplains, resulting in high levels of sediment in spawning gravels (Swanston 1991).

Desired Upland Vegetation:

Functioning Appropriately - Forested communities are within recommended canopy closures and/or openings (early seral condition) account for approximately 5-20% of the subwatershed; meadow and other upland communities have little or no conifer encroachment. This is the desired condition.

Functioning Appropriately but-at-Risk - Less than 50% of forest communities are outside recommended canopy closure ranges and/or openings (early seral condition) account for approximately 20-30% of the subwatershed; meadows and other upland communities have experienced conifer encroachment.

Functioning Inappropriately - Over 50% of forested communities are outside recommended canopy ranges and/or openings (early seral condition) account for more than 30% of the subwatershed; the majority of meadow and other upland communities have a high level of conifer encroachment.

2. Road Density, Location, and Drainage Network, and their Effect on the Amount of Sediment and Water Reaching Riparian Areas

Roads account for most of the sediment problems in a watershed because they are a link between sediment source areas (skid trails, landings, and cutslopes, etc.) and stream channels. They directly affect the channel morphology of streams by accelerating erosion and sediment delivery and by increasing the magnitude of peak flows (Furniss et al. 1991). Wemple (1994) focused on the interaction of forested roads with stream networks and found that nearly 60% of the road network

drained into streams and gullies, and are therefore, hydrologically integrated with the stream network. Sediment entering streams from roads is delivered by mass soil movements, surface erosion, failure of stream crossings, and accelerated scour at culvert outlets (Furniss et al. 1991). Further, a study on the Medicine Bow National Forest showed that fine sediment increased as culvert density increased (Faglin 1991).

To reduce the adverse effects of roads on aquatic resources, road miles should be progressively decreased through permanent closure or obliteration in subwatersheds with high (1.7 - 4.7 road mi/mi²) and extreme (>4.7 road mi/mi²) road densities (Interior Columbia Basin Ecosystem Management Project (ICBEMP) 1997). A study of eroded material travel distances below fill slopes shows that more than 95% of relief culverts can be prevented from contributing sediment to streams if the travel distance from the culvert outlet to the stream is at least 300 feet. When broad-based dips are used for drainage, instead of culverts, nearly 100% of the contributing eroded material stopped within 100 feet of the road prism (Burroughs and King 1989). As a result, INFISH (1995) recommends buffer strips of 300 feet between riparian areas and roads. Also, maintaining a buffer between the road and stream channel provides a filter that minimizes the introduction of fine sediment into the stream channel.

Desired Road Densities:

Functioning Appropriately - Road density less than 1.7 mi/mi². This is the desired condition.

Functioning Appropriately but-at-Risk - Road density of 1.7 - 4.7 mi/mi²

Functioning Inappropriately - Road density greater than 4.7 mi/mi².

It is assumed that the number of stream crossings and roads that are within 300 feet of streams are in relative proportion to the above road densities.

Riparian Vegetation and Stream Channels

Key Question 2: Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

Parameters: 1. Desired riparian vegetation and bank stability
2. Desired Rosgen stream types

1. Riparian Vegetation and Associated Bank Stability

One of the many functions of riparian plants is to stabilize banks through root mass. Manning et al. (1989) documented that sedge and rush species produced significantly more root mass than dry-land grasses, making these plants conducive to high bank stability. Other vegetation types such as willows, cottonwoods, and conifers provide additional bank stability. The stems of these herbaceous and shrub species provide roughness and resistance to high flows, which allows for sediment trapping and bank building (Elmore and Beschta 1987). Under these conditions, water is stored during the wet season and slowly released to the stream during the summer months. In an area where sheets of ice form on the stream surface during the winter--such as the Upper Sycan River Watershed--ice break-up during spring thaw accelerates bank erosion when riparian vegetation is absent (Platts 1991).

The vegetation types that contribute to the above conditions have been described. Willow, sedge, and rush associations characterize late-seral communities in low gradient meadow stream systems, where approximately 95% of the riparian area provides conditions for late-seral species (Burton et al. 1992). Along steeper-gradient mountain streams, where at least 75% of the bank substrate supports late-seral species, mountain alder will dominate the site while black cottonwood, willows, sedges, grasses, are subdominant (Burton et al. 1992, Kovalchik 1987). Early seral species, such as grasses, occupy riparian areas, but under reference conditions these species are subdominant (Kovalchik 1987). The relationship between these plant types and bank stability is reflected in the Native Inland Fish Strategy (USDA 1995) which details standards and guidelines that suggest bank stability should be greater than 80%. The Interior Columbia Basin Ecosystem Management Project

recommends 90% for areas where this is attainable (ICBEMP 1997).

Desired Riparian Vegetation and Bank Stability:

Functioning Appropriately - Riparian communities are highly similar to the late-seral species composition and structure described by Burton et al. (1992), Kovalchik (1987), and bank stability >90%. This is the desired condition.

Functioning Appropriately but-at-Risk - Riparian communities are moderately similar to the late-seral species composition and structure described by Burton et al. (1992), Kovalchik (1987), and bank stability is 80-90%.

Functioning Inappropriately - Riparian communities have low similarity to the late-seral species composition and structure described by Burton et al. (1992), Kovalchik (1987), and bank stability is <80%.

2. Rosgen Stream Types

Stream classification systems are an attempt to simplify complex relationships between streams and associated watersheds. Anderson et al. (1998) suggests that a purpose of classification systems is to describe a stream's position in the landscape and the range of variability for parameters related to channel size, shape, and pattern. Channel morphology measurements associated with a particular classification system provide a great deal of information in determining whether or not the width-to-depth ratio, sinuosity, and gradient of a stream are in balance with the landscape setting. A stream's ability to dissipate energy is closely tied to its sinuosity, width-to-depth ratio, and gradient. When one of these parameters is altered, the stream becomes out of balance in terms of the shape and size expected for its setting. For example, a decrease in sinuosity (stream length relative to valley length) results in a higher stream gradient, which in-turn increases velocities. Increased velocities lead to accelerated erosion, which may further alter channel shape and gradient.

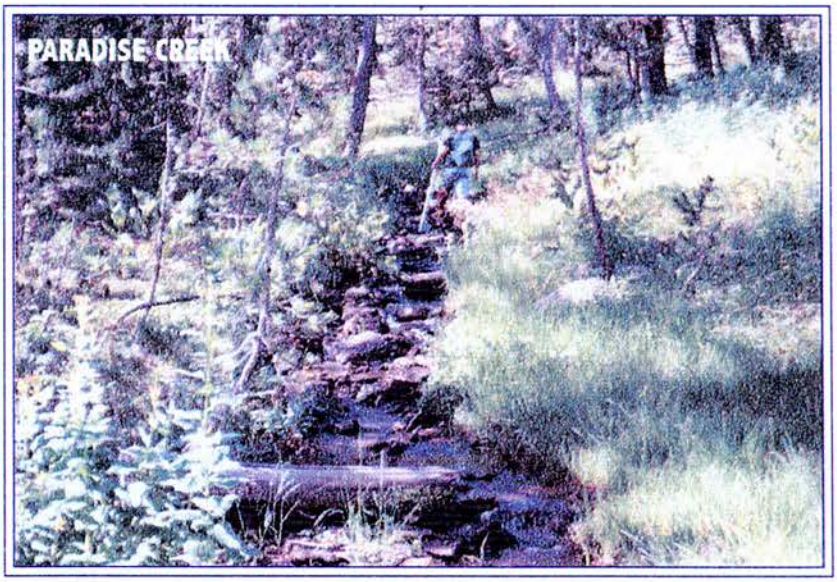
For this assessment, the Rosgen Classification system was selected because it aids in describing the natural potential of each stream, based on numerous measurements, such as entrenchment, bankfull width-to-depth ratio, sinuosity, gradient, and dominant channel substrate (Rosgen 1996). *Entrenchment* is the vertical containment of the stream channel and refers to the ability of a stream to access its floodplain. The stream is entrenched when floodwaters are confined to the channel and is not entrenched when floodwaters are able to access the floodplain. *Bankfull width-to-depth ratio* indicates the shape of the channel, and is the ratio of bankfull width to mean bankfull depth. Bankfull stage is the point at which the stream accesses its floodplain and is a required measurement in order to determine width-to-depth ratios. It is synonymous to the flood stage, has an average return interval of 1.5 years (Leopold 1964), and is considered the channel forming flow. Width-to-depth ratios indicate whether the stream is wide and shallow or narrow and deep. *Sinuosity* refers to the extent with which a stream meanders across the landscape. Highly sinuous streams have many meanders and curves, while streams with low sinuosity are straighter with few meanders and curves. Gradient is the slope or steepness of the stream while the *dominant channel substrate* refers to the size of particle or rock that covers the stream channel. Rosgen (1996) describes enhancement methods that work with natural processes of the stream, for each channel type.

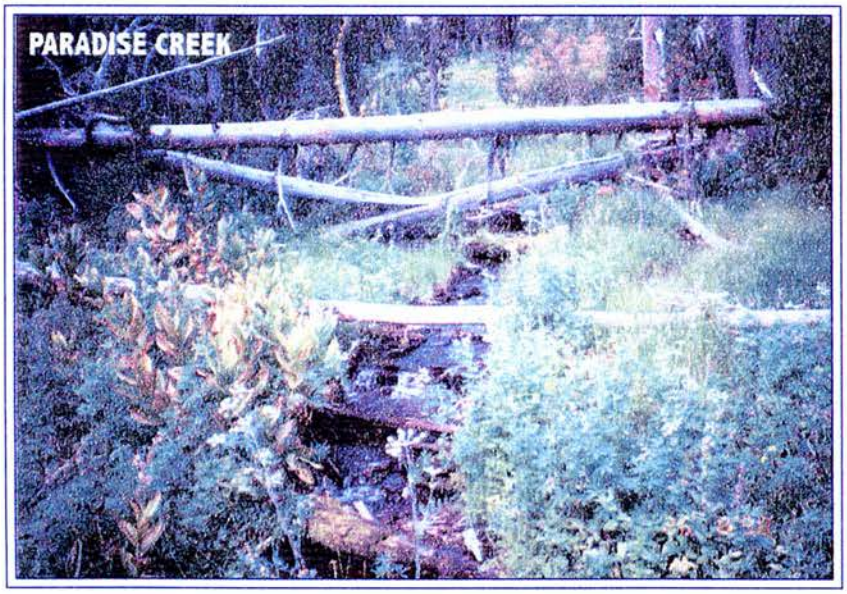
Desired Rosgen Stream Types:

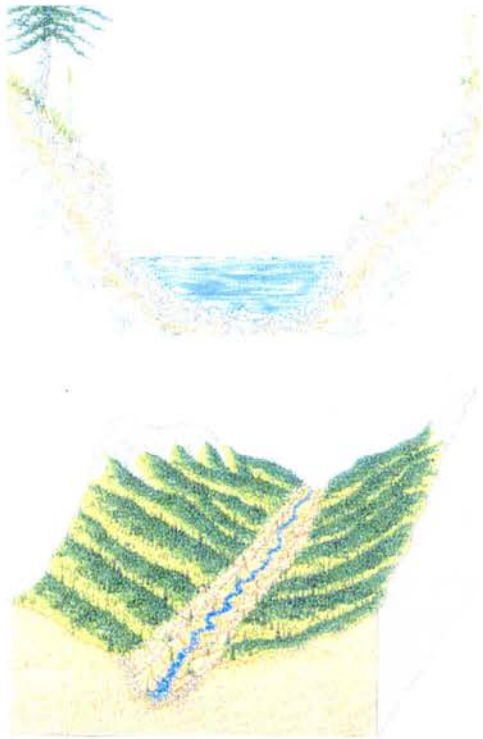
Surveys conducted in the Upper Sycan River Watershed reveal stream types A, B, C, and E. The stream type descriptions illustrated on the following 4 pages are based on Rosgen (1996). Numbers, which follow the letter designation, refer to substrate size – for example "E4" would be a Rosgen Type E stream dominated by a gravel substrate. In this summary, the number "4" refers to gravel sized substrate, while "3" refers to substrate ranging from baseball to basketball size.

Rosgen A Stream Type

Rosgen A stream types are characterized by steep gradients (between 4 and 10%), with deeply incised channels, and entrenchment ratios <1.4. They have low width/depth ratios (<12) and low sinuosity (<1.2). Local landform and geology dictates channel stability. The A3 channel types, found in the Upper Sycan Watershed, are characterized by a high sensitivity to disturbance, very high stream bank erosion potential, and vegetation having a negligible influence in determining channel stability. Overall, these channels exhibit high sediment supply and transport potential. Large woody debris plays a significant role in determining frequency of step pools which provides fish habitat and overall channel stability.







Delineative Criteria (A3)

Landform/soils: Steep narrow depositional slopes typical of glacial moraines and debris slides associated with unconsolidated, heterogenous and non-cohesive materials.

Channel Materials: Predominately cobble with a mixture of boulders, gravel and sand.

Slope Range: .04 - .10 (A3a+ > .10)

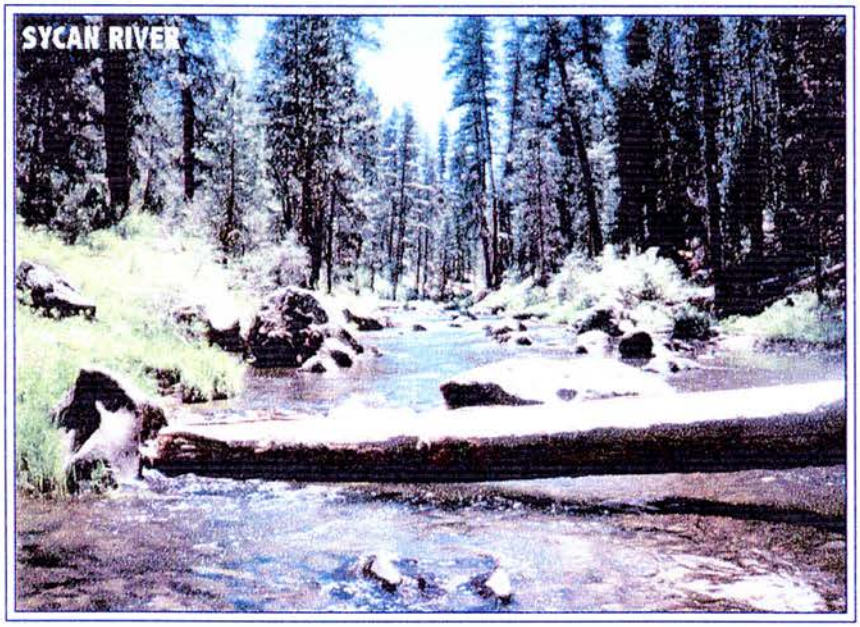
Entrenchment ratio: < 1.4

Width/depth Ratio: < 12

Sinuosity: <1.2

Rosgen B Stream Type

Rosgen B stream types are moderately steep (between 2 and 4%), with rapids and riffles common and scour pools irregularly spaced. These stream types are moderately entrenched (1.4-2.2), with moderate width-to-depth ratios (>12) and sinuosity (>1.2). They are found within "V" type valleys, usually in forested systems, with substrates ranging from gravel (B3) to cobble (B4). Vegetation has a moderate influence in determining channel stability. These channel types are characterized by low to moderate sensitivity to disturbance and low streambank erosion. Fish habitat is often associated with large woody debris which contributes to scour pool formation and cover.



Delineative Criteria (B3)

Landform/soils: Narrow, moderately steep colluvial valley with gentle side slopes. Soils are colluvium and/or alluvium. Often in fault line valleys or on well vegetated alluvial fans.

Channel Materials: Predominately cobble with lesser amounts of boulders, gravel and sand. Streambanks are stable due to coarse material.

Slope Range: .02 - .04 (B3c, < .02)

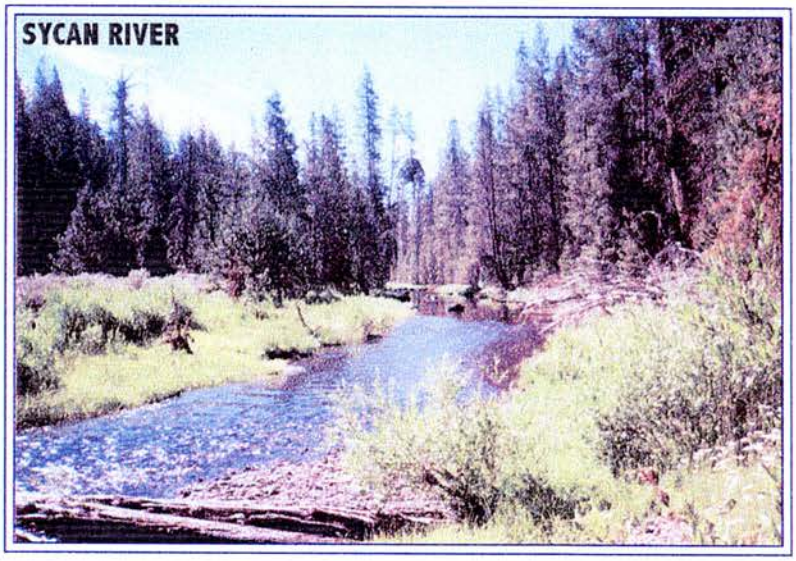
Entrenchment Ratio: 1.4-2.2

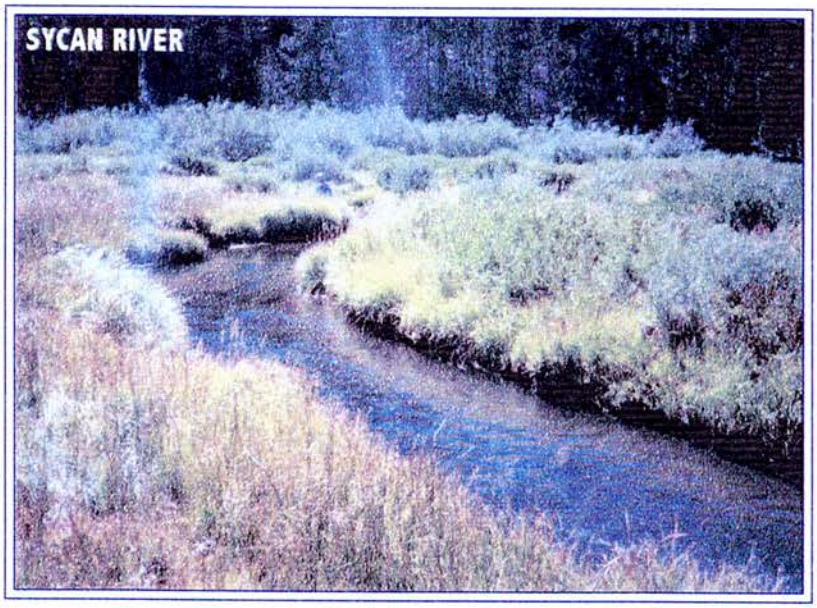
Width/depth Ratio: > 12

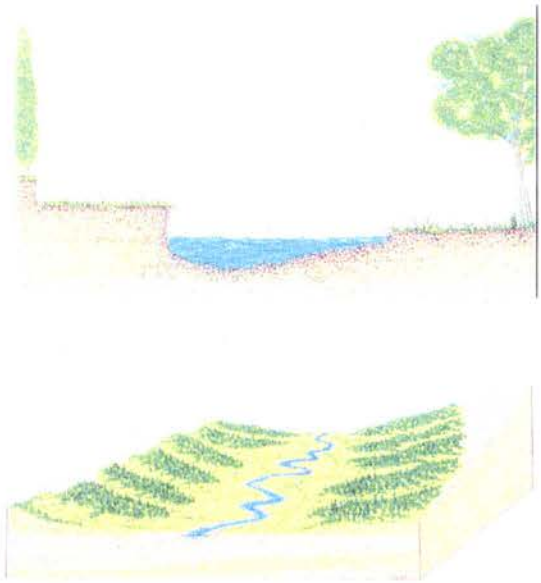
Sinuosity: >1.2

Rosgen C Stream Type

Rosgen C streams types are lower gradient streams which are slightly entrenched (>2.2), have moderate to high (>12) width-to-depth ratios, high sinuosity values (>1.4), and are characterized by riffle/pool sequences. Streams within the watershed are often found in low gradient alluvial valleys with substrates dominated by gravel (C4). Channels have characteristic point bars and broad, well defined floodplains. Vegetation has a very high influence in determining channel stability, and when vegetation is disturbed and removed, these channel types are highly sensitive to both lateral (bank) and vertical (downcutting) erosion. Natural sediment supply is moderate to high except in those areas where stream banks are well vegetated. These streams are highly sensitive to changes in sediment and stream flow.







Delineative Criteria (C4)

Landform/soils: Broad, gentle gradient alluvial valleys and river deltas. Soils are alluvium.

Channel Materials: Predominately gravel, with lesser amounts of cobble, sand and silt/clay.

Slope Range: < .02 (C4c- .001)

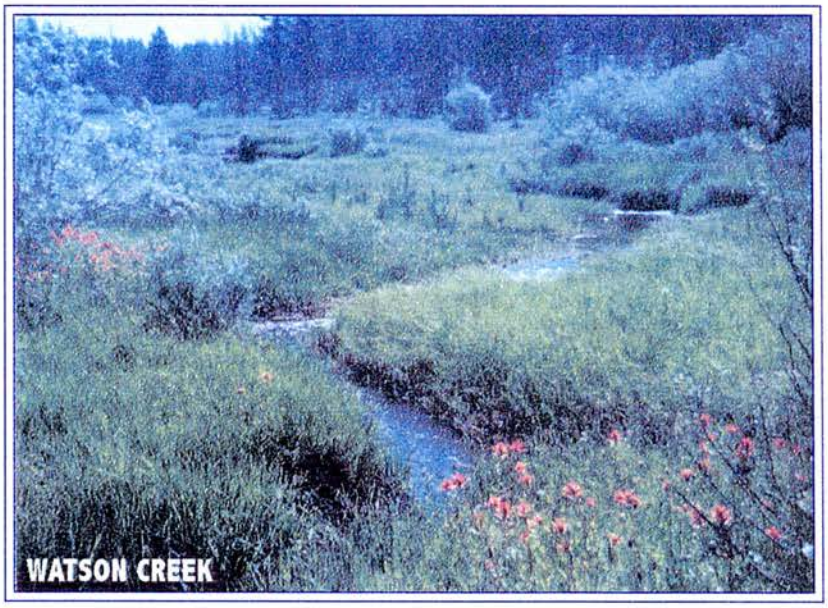
Entrenchment ratio: > 2.2

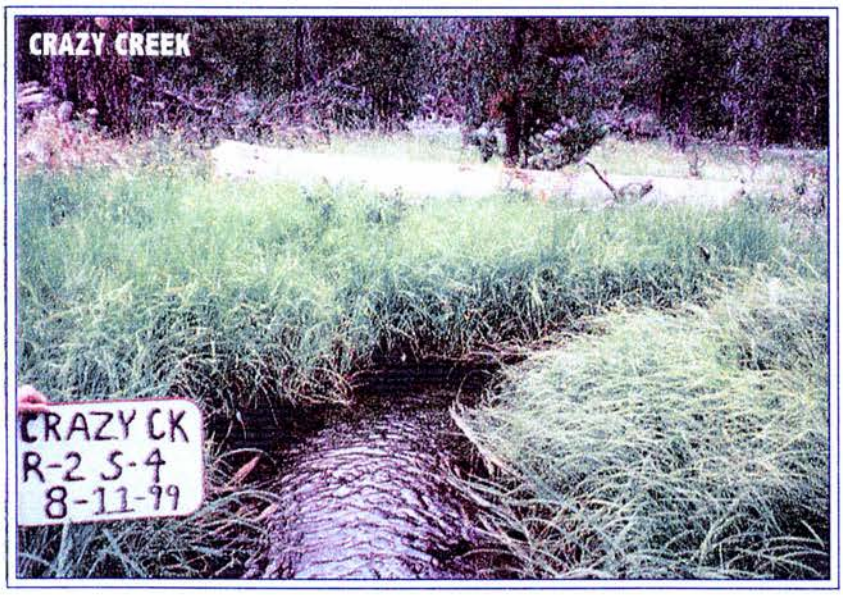
Width/depth Ratio: > 12

Sinuosity: > 1.4

Rosgen E Stream Type

Rosgen E stream types are low-gradient streams (<2%, but can reach 4%) which are slightly entrenched (>2.2) with low width-to-depth ratios (<12), and high sinuosity (>1.5), with riffle/pool sequences and well developed floodplains. In the Upper Sycan Watershed, channel substrate is dominated by gravel (E4) and to a lesser degree cobble (E3). Valleys are usually wide and gently sloped. Vegetation has a very high influence on channel stability. When it is lacking, these channel types are highly sensitive to disturbance which may result in increased levels of streambank erosion and downcutting. These streams are highly sensitive to changes in sediment and stream flow. The E stream type provides excellent fish habitat through undercut banks, clean spawning gravels, and numerous deep pools.





Delineative Criteria (E4)

Landform/soils: Gentle slopes in broad riverine or lacustrine valleys and river deltas.

Channel Materials: Gravel dominated bed with smaller accumulations of sand and occasional cobble. Streambanks composed of sandy/gravel mixture with dense root mat.

Slope Range: < 0.02

Entrenchment ratio: > 2.2

Width/depth Ratio: < 12

Sinuosity: >1.5

Desired Channel Evolution for a Degraded Low-Gradient System: When vegetation is lacking along an E stream type, lateral (bank) and vertical (downcutting) erosion may lead to progressive stages of channel adjustment, resulting in altered channel dimension, pattern, and profile. As a result of the bank erosion and downcutting, the channel becomes wider and shallower, resulting in a higher width/depth ratio (a conversion from an E to C stream type). During downcutting events, the channel becomes an incised gully, straighter and steeper than the original channel—a G stream type. In doing so, the channel abandons its original floodplain, resulting in a lowered water table. Although downcutting subsides, lateral erosion continues because flood energies are confined within the incised channel. As the banks erode, the width-to-depth ratio continues to increase, creating a wide, shallow, and entrenched stream with no floodplain--an F stream type. The lateral erosion will continue until a floodplain is developed that is wide enough to dissipate flood energies. The development of a floodplain will only occur with good riparian vegetation that is resistant to flows and able to trap sediments and build banks. This will continue until the stream reaches a condition where it is naturally stable and in balance with the landscape setting. Once at this desired state (an E stream type), the stream is able to accommodate the flow and sediment produced by its watershed while maintaining its dimension, pattern and profile.

Functioning Appropriately - stream channel is highly similar to the Rosgen stream type expected for its setting.

Functioning Appropriately but-at-Risk - stream channel is highly similar to the Rosgen stream type expected for it's setting, but its bankfull width-to-depth ratio is larger than expected.

Functioning Inappropriately - stream channel is different from the Rosgen stream type expected for its setting (i.e. we expect an E stream type and it is an F stream type).

Data collected from stream surveys in both the Upper Sycan River and Chewaucan River watersheds indicate that E stream types are expected in low gradient meadow reaches with a drainage area of less than 18 square miles, while C Stream Types are expected where drainage areas exceed approximately 18 square miles.

Habitat for Aquatic Species

Key Question 3: Are the stream channels providing adequate fish habitat?

Parameters:
1. Desired amount of large woody debris
2. Desired pool numbers
3. Desired percentage of fines in spawning gravel
4. Desired stream temperature
5. Desired fish passage - culverts

1. Large Woody Debris (LWD) and its Contribution to Fish Habitat

Large woody debris in streams is an important roughness element influencing channel morphology, sediment distribution, and water routing (Swanson and Lienkaemper 1978, Bisson et al. 1987). Large wood forms a step gradient, a stair-step effect along the channel. As a result, stream velocity is reduced in the relatively long stretches between debris steps and increases where water falls over the logs. A straight stream will be converted into a more sinuous or meandering stream with the LWD (Swanson 1991). These alterations in flow patterns may either protect or erode banks, but in general, this energy distribution reduces the streams ability to erode banks and enhances sediment storage (Zimmerman et al. 1967). Wood also serves as an important agent in pool formation. For instance, in southeast Alaska streams, LWD accounted for up to 75% of all pools (Robison and Beschta 1990). The resulting effect on fish habitat is significant. Large wood in the low energy segments traps organic matter such as leaves, which remains in the stream longer, providing food for aquatic organisms (Speaker et al. 1984). Reeves et al. (1991) notes that low velocity areas required by fish--during floods--increase with additional LWD. Bjornn and Reiser (1991) cited several studies that documented an increase in fish densities with higher levels of LWD. It should be noted that the role of LWD decreases as streams become larger, because greater currents will carry the wood out of the active channel and onto the banks (Murphy and Meehan 1991).

Desired amount of LWD:

Large woody debris is evaluated against the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (ICBEMP 1997).

Functioning Appropriately - Large woody debris numbers are >75th percentile. This is the desired condition.

Functioning Appropriately but-at-Risk - Large woody debris numbers are ≥ 50th and ≤ 75th percentile.

Functioning Inappropriately - Large woody debris numbers are <50th percentile.

For this assessment, LWD is defined as being 20 inches in diameter on the small end and greater than 35 feet long in ponderosa pine and mixed conifer sites. In lodgepole pine sites, LWD is defined as 12" in diameter and greater than 35 feet long. The natural or near natural frequency is determined using the table below, and the formula for desired numbers per mile = table value x 5280/average riffle width in feet. For example, a stream with a 10-foot average riffle width and a slope of 2-4% would be expected to have 11 pieces of LWD/mile at the 50th percentile and 45 pieces at the 75th.

Table 4.2 - Natural or Near Natural Frequency of LWD in Northern Great Basin Streams (ICBEMP 1997).

	Large Woody Debris/Mile	
Slope Class	50th Percentile	75th Percentile
All	0.019	0.062
<2%	0.006	0.025
2-4%	0.02	0.085
>4%	0.02	0.067

2. Pools and their Contribution to Fish Habitat

Pools are considered to be one of the most important fish habitat features, and for most fish, pools are the preferred habitat type (Bestcha and Platts 1986). Reeves et al. (1991) describes some of the reasons why trout use this habitat type: pools offer low velocity refuges, cooler stream temperatures during the summer months and over-wintering habitat. Furthermore, the majority of trout spawning occurs at pool tailouts, where spawning gravel is deposited (Bjornn and Reiser 1991, Reeves et al. 1991). In addition, pools provide rearing habitat for juvenile fish and resting habitat for adult fish (Bjornn and Reiser 1991), and refugia from drought, fire, winter icing and other disturbances (Sedell et. al. 1990). When pool numbers, volume, and complexity increases, the stream's capacity to support a diversity of species and life stages/history types increases (Bisson et. al. 1992; Bjornn and Reiser 1991). Further, Decker and Erman (1992) found that rainbow trout numbers were more abundant with an increase in pool habitat. Finally, an increase in pool numbers and complexity produces conditions for increased fish numbers and biomass (Fausch and Northcote 1992).

Desired Pool Numbers:

The number of pools, and large pools, is evaluated against the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (ICBEMP 1997). Large pools are those that have a depth of greater than 2.6 feet during low flow.

Functioning Appropriately - Pool numbers are >75th percentile. This is the desired condition.

Functioning Appropriately but-at-Risk - Pool numbers are ≥50th and ≤75th percentile.

Functioning Inappropriately - Pool numbers are <50th percentile.

The natural or near natural frequency is determined using the table below, and the formula for desired numbers per mile = table value x 5280/average riffle width in feet. For example, a stream 10 feet wide with a slope of <2% would be expected to have 14 pools/mile at the 50th percentile and 28 pools/mile of at the 75th percentile.

Table 4.3 - Natural or Near Natural Frequency of Pools in Northern Great Basin Streams (ICBEMP 1997).

Slope Class	Pools/Mile (all pools)		Large Pools/Mile	
	50th Percentile	75th Percentile	50th Percentile	75th Percentile
All	0.027	0.049	0.000	0.003
<2%	0.027	0.053	0.000	0.005
2-4%	0.029	0.044	0.001	0.004
>4%	0.030	0.051	0.000	0.000

3. Spawning Gravel Fines and their Influence on Fish Habitat and Reproductive Success

Willers (1991), describes the effects of spawning gravel size on egg and alevin survival (hatched fish that have not emerged from spawning gravels). In general, he states mortality increases as spawning gravel size decreases because fine sediment impedes the flow of oxygenated water over the eggs or can trap the alevins in the gravel. Likewise, other studies show an inverse relationship between fine sediment and reproductive success (Everest et al. 1987). Bjornn and Reiser (1991) documented rainbow trout embryo survival as it related to substrate fines <6.4 mm: 90% embryo survival with fines at 10%, 75% embryo survival with fines at 20%, and 50% embryo survival with fines at 30%. In general, habitat guidelines for incubation of salmonid embryos require less than 25% volume of fines. Sieve analysis of potential spawning substrate has been conducted forest-wide in a broad range of geologic types. The reference level of fines for a particular geologic type has not been identified; however, analysis shows that a level of less than 30% fines is generally attainable in the top four inches of spawning substrate throughout the Fremont National Forest. Based on this information and ICBEMP (1997) recommendations, desired conditions for spawning substrates were determined.

Desired Percentage of fines in Spawning Gravels:

Functioning Appropriately - <20% fines for C and E stream types, and <25% fines for A and B stream types. This is the desired condition.

Functioning Appropriately but-at-Risk - 20-30% fines for C and E stream types, and 25-30% fines for A and B stream types.

Functioning Inappropriately - >30% fines for all stream types.

4. Stream Temperature and its Influence on Fish Habitat

Stream temperature is an important factor regulating aquatic life. Fish are cold blooded, and thus, assume the temperature of the water in which they live. For this reason, a fish's metabolism, and consequently their growth and development, are directly controlled by their thermal environment (Brown 1983). Therefore, the growth and survival of fish can be greatly affected by temperature extremes (Beschta et al. 1987). Because stream temperature affects fish habitat, the Oregon Department of Environmental Quality (DEQ) has established a state water quality temperature criteria: 7 consecutive average daily maximum temperatures are to be at or below 17.8°C (64°F) with fish being the primary benefiting resource. Generally, water temperatures in excess of 21°C (70°F) are unfavorable and may cause stress to all age classes (Sigler and Sigler 1991). However, Behnke (1992) states that redband trout possess a hereditary basis to persist at higher water temperatures than other species of trout. Further, Sonski (1985) noted that redband trout raised in a hatchery increased growth until 24°C (75°F) and recommended temperatures ranging from 18.3 to 23.8°C (65 to 75°F) to keep broodstock in good condition. Behnke (1992) has captured (fly-fishing) live redband in streams with temperatures of 28.3°C (82.9°F). Finally, temperatures exceeding 29.4°C (84.9°F) can be fatal to rainbow trout (Bjornn and Reiser 1991). It should be noted that desired stream temperatures are discussed in relation to redband trout, since these fish are the only native trout known to exist within the Upper Sycan Watershed. Bull trout were not found in recent ODF&W surveys, nor were they noted during USFS Level II stream surveys.

Desired Stream Temperatures:

Functioning Appropriately - Seven-day maximum stream temperatures are < 17.8°C. This is the desired condition.

Functioning Appropriately but-at-Risk - Seven-day maximum stream temperatures are between 17.8°C and 24.0°C.

Functioning Inappropriately - Seven-day maximum stream temperatures are >24.0°C.

5) Fish Passage--Culverts

Fish need to move up and down streams for a variety of reasons, including spawning migration and to seek more suitable habitat as a result of competition or unfavorable stream temperature. It has been documented that redband trout traveled 300 feet on Elder Creek, a major tributary of the Chewaucan River, from June until November (Osborn 1967). However, redband may move even greater distances to seek more suitable water temperatures (Bjornn and Reiser 1991), particularly during the summer months and when seeking spawning habitat during April and May (Kunkel 1976).

Road culverts can block the movement of fish; the most common access inhibitors being excessive water velocities and associated vertical drops (Baker and Votapka 1990). When assessing culverts for trout passage, the following parameters should be evaluated: (1) jumping pools, (2) vertical jumps of <1 foot, (3) velocities that do not exceed maximum sustained swimming speed, and (4) culvert length (Furniss et al. 1991). Baker and Votapka (1990) document sustained speeds of rainbow trout being 2.0 - 6.6 feet per second. Further, as the water velocity increases, the length of a culvert that a trout can swim through decreases. For example, a trout can maneuver through a 50-foot culvert with water velocities up to 3 feet per second; however, at water velocities of 4 feet per second, a trout can only swim through a 30-foot culvert.

Desired Fish Passage:

Functioning Appropriately - All culverts are passable. This is the desired condition.

Functioning Appropriately but-at-Risk - When a culvert is a barrier in the middle to upper reaches of a subwatershed.

Functioning Inappropriately - When a culvert is a barrier in the lower reaches of a subwatershed.

Key Question 4: How are the above subwatershed conditions influencing native trout viability?

Parameters: 1. Desired native trout viability

Population viability addresses the continued existence of well-distributed populations or subpopulations over specific time periods (Marcot and Murphy 1996). High genetic variability will help ensure the viability of populations. Meffe (1996) states that genetic variability of a population determines its fitness or ability to respond and adapt to environmental changes, and low genetic variability may result in decreased adaptability. This variability, Meffe continues, can be maintained by managing for a hierarchy of habitat types across a geographical area and uses stream order as an example for stratification. Salmonids within first order streams may contain subtle genetic differences from fish in the second and third order streams of the watershed; however, the genetic constitution of these fish can diverge genetically from fish in other first order streams in different watersheds. Applying this concept to the Upper Sycan River Watershed, native redband trout occupying the upper reaches of the Paradise Creek subwatershed may possess subtle genetic differences from redband in the upper reaches of the Sycan River. It is important to manage for a diversity of high-quality habitat types to maintain genetic diversity (Meffe 1996).

Meffe's concept fits within the context of metapopulation theory. Noss et al. (1997) defines a metapopulation as a group of subpopulations, spatially distinct but connected by at least occasional dispersal. Because the Upper Sycan redband are part of the larger Klamath Basin populations, they are considered a part of this metapopulation. Applying the metapopulation concept to the Upper Sycan River Watershed, each subwatershed may host a separate subpopulation.

A reserve is an area of high-quality habitat that can sustain a viable subpopulation. In this document, reserves in the context

of a subwatershed will be assessed. Several principles should be considered when evaluating an individual reserve or network of reserves. Reserves should be well distributed across the landscape, the idea being that widely distributed subpopulations will not experience a catastrophe or adverse impact across its entire range. Some subpopulations will escape the impact, eventually re-colonize the affected area, and sustain the population as a whole. Secondly, large reserves are better than small ones, because there is a greater opportunity for habitat diversity and larger population size. As a result, genetic variability within the subpopulation will be optimized, promoting increased adaptability to environmental change. Thirdly, reserves that are close together are better than those far apart. A short travel distance between reserves promotes dispersion and genetic interchange. If enough interchange occurs between reserves, fish are functionally united into a larger population that can better avoid extinction. In other words, connectivity between reserves is required. Finally, the above three principles can be achieved by managing at the landscape level, managing for watershed conditions that are within the natural range of variability (Noss et al. 1997).

Desired native trout viability:

Functioning Appropriately - The uplands are producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas and stream channels, resulting in high-quality habitat and connectivity. Under current management, habitat conditions are able to recover from one short-term disturbance (i.e. flood or small-scale wildfire) within one or two generations (3-5 years).

Functioning Appropriately but-at-Risk - The uplands are producing hydrological conditions (water and sediment outputs) that are adversely affecting--or have the potential for adversely affecting--the functioning of riparian areas and stream channels, contributing to reduced habitat quality and connectivity over a portion of the subwatershed. Under current management, altered habitat conditions will not recover to pre-disturbance conditions within one or two generations (3-5 years).

Functioning Inappropriately - The uplands are producing hydrological conditions (water and sediment outputs) that are adversely affecting the functioning of riparian areas and stream channels, resulting in low quality habitat and connectivity over much of the subwatershed. Under current management, habitat conditions are not expected to improve within one to two generations (5-10 years).

II. Vegetation

The best information available on the historic vegetative types in the Upper Sycan Watershed comes from the 1946 and 1947 Timber Type Maps. While the terminology used in this historic mapping differs from designations currently in use, interpretation of the data indicates that it is reasonable to use the information to provide a comparison of historic and current forest vegetation conditions. The table below summarizes the information contained in the 1946 and 1947 Timber Type Maps. National Forest lands and private lands are included, together, in the data.

Table. 4.4 1946-47 Vegetation Condition

Vegetation Type	Approximate Acres	% of Watershed
Ponderosa Pine - Large	29,600	46
Ponderosa Pine - Seedling, Saplings and Poles	130	-
Lodgepole Pine - Large	2	-
Lodgepole Pine - Small and Medium	24,400	37
Mixed Pine - Large	110	-
White Fir – Large	50	-
Hardwood	1,300	2
Ponderosa Pine Woodland	600	1
TOTAL FORESTED	56,200	86
Grass, Sagebrush, Brush	8,800	14
TOTAL FOREST and NON-FOREST	65,000	100

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?

3. What rare or designated sensitive plants occur in the watershed?

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?

Forested Uplands

Historically, the size, structure, composition, and spatial arrangement of the three basic forest plant community types which exist within the Upper Sycan Watershed (ponderosa pine, mixed conifer, lodgepole pine) was mainly the product of natural fire frequency and intensity. Other disturbance factors did play a role. Insects, diseases, and abiotic events such as windstorms did affect the development of vegetation, but fires were the ever-constant pressure that shaped stand composition and drove plant succession. Aboriginal burning in this area was likely but was not significant on a landscape basis.

Ecologic disturbance is a complex study, but three important axioms are that:

1. There is an inverse relationship between fire frequency and intensity.
2. There exists a direct relationship between the degree of deviation from historic variability and the number of "fire cycles" skipped due to artificial pressures. Skipped fire cycles tend to accelerate "biologic" plant succession.
3. Not only is there variability of fire frequency and intensity between plant associations, but the frequency has also varied over time (Agee 1993).

This discussion will limit itself to fire histories evidenced over the past 1000 years. A discussion on fire ecology and ecologic mechanisms is supplemented in the Step 3 - Current Condition.

PONDEROSA PINE

Nature's ancient alliance with fire can be seen throughout the United States. The west's vast ponderosa pine forests are among the most fire dependent. Denied a fire every 5 to 25 years, they become primed for destruction (Stephen Pyne 1996). Frequent light surface fires with a low degree of variability characterized the natural fire regime for ponderosa pine. Historic fire return intervals of 1 to 25 years have been measured within similar watersheds. In other words, based on core sample research throughout the region, these stands burned on a regular basis with a high degree of predictability. Stand replacement fires were very rare. The average ponderosa stand today has skipped approximately 10 fire episodes and shows the greatest departure from reference conditions.

1. Spatial Arrangement

Naturally occurring fire maintained ponderosa pine type stands at different spatial arrangements on the landscape than we see them today. Stand structure analysis has revealed that historically, ponderosa pine forests grew in clumps of even-aged, uniformly spaced trees, a condition that was sustainable in a fire dependent ecosystem. Fires were described as creeping through the understory consuming branches, litterfall, grass and forbs on the forest floor. Ponderosa tended not to expand out through the sage and grass communities as we see them today. Looking at the edge of most grass/sage "meadows" there typically is a band of young ponderosa pine, 100 to 300 feet wide in front of the Late or Old Successional (LOS) ponderosa stand. That band of younger trees has encroached onto the meadow due to the elimination of fires this century.

Unlike the ponderosa invasion into the drier end of its range, ponderosa pine has been displaced by true fir at the wetter end. These stands are progressing in biological plant succession. In general, most of today's mixed conifer plant communities, on all aspects below 6000 feet, and on south and west aspects above 6,000 feet functioned as ponderosa pine with a fire frequency pushing the higher 25-year interval.

Ponderosa pine stands tended to be large and extensive across the landscape. Gaps and patches occurred at irregular intervals across these stands. They probably ranged from 1/4 acre to as large as 40 acres (Hopkins 1993). Fragmentation across the landscape would have been considered low at the large scale yet some stands may have contained a higher degree of patchiness when looked at a finer scale. Other disturbance factors had little effect on the large-scale spatial arrangement of ponderosa pine types. Due to the uneven-aged/even-sized/low stocked nature of the canopy, these stands were highly resistant to large-scale mortality. Insect activity would have tended to be light. Predisposal of infestations at the stand level would have been rare due to the fact that the fire regime wouldn't allow stand densities to grow to a high risk condition. Trigger factors for bark beetle attacks would have been at the singular tree or small group level; i.e. lightning and fire scars or a patch of age related mortality.

2. Size/Structure

When John C. Fremont explored this region in 1843, he reported finding vast stands of timber typically described as "open" or "park-like." There were few, well-spaced trees of mammoth size (Hopkins 1993). In general, the ponderosa pine types tended to have LOS, single stratum characteristics, maintained for long periods of time with low intensity surface fires. Amounts of shrubs and large down wood was variable but tended to be sparse. The multi-stratum structures we see today couldn't exist long due to this historic fire regime. Though the stands where single stratum, there was a great variance in ages within the canopy. Pulses of regeneration would escape the understory in patches ranging from 1/4 acre to as much as 40 acres then maintain as codominants in the canopy.

The ponderosa pine forests tended to look "park like" and carry much less stocking than the stands of today. It is estimated that these forests produced as much as 30% less biomass then they do today (Hopkins 1993).

These even-sized/uneven-aged stands tended to be resistant to most other disturbance factors. Insect, wind, or disease mortality was largely restricted to singular or small groups of trees. The larger gaps allowed the shade intolerant ponderosa to regenerate. Due to the single-stratum structure, dwarf mistletoes tended to be confined. Frequent fires would have eradicated heavy infections and aided in creating gaps for regeneration. Root diseases would have been opportunists infecting the oldest and weakened trees. Though variable, their virulence may have been kept low due to the resistance of the pine species.

Comandra blister rust is a little known pathogen. Ecologists suspect that up to 10 percent of trees exhibited spire tops caused by the disease (Hopkins 1993). This process helped maintain snag habitat in an environment where true snags burned up quickly.

As the axioms predict, ponderosa pine plant communities today exhibit the greatest departure from reference conditions.

Reference Seral Stage Distribution in the Ponderosa Pine Type

Early to Mid (unstocked to small sawtimber)	20% (95% single story, 5% multi story)
Late (medium sawtimber and greater)	80% (95% single story, 5% multi story)

Data interpreted from the 1994 REAP Report and the 1947 timber type map.

MIXED CONIFER

The natural fire regime for mixed conifer/pine associated types is characterized by a highly variable range of intensities from infrequent severe surface fire to long return crown fires. The associated fire return frequencies range from 25 to 300 years. Fires burned on an irregular basis with a low degree of predictability. The average mixed conifer stand today may have skipped 1 to 2 fire cycles. Wildfires today probably cover more acreage and burn hotter than they did in the past but inherent

variability has prevented generalizations about fire and its ecological effects. In general, the mixed conifer stands have not changed as radically as have the ponderosa pine type.

1. Spatial Arrangement

In general, mixed conifer stands have expanded aggressively into the drier ponderosa pine types and somewhat into colder lodgepole pine communities. A patchwork of even-aged and uneven-aged stands attest to the variability of past fire intensities.

True mixed conifer stands tended to be variable in size but remained somewhat fragmented. Many of the mixed conifer patches were actually stands that functioned as ponderosa pine types.

2. Size/Structure

In general, the mixed conifer stands tended to be small, and heterogeneous (variation within a stand), that exhibited a gradient of seral conditions across the stand as well as the landscape. The younger end of this gradient tended to be even-aged/even-sized "pioneer" species such as ponderosa and lodgepole pine. As the stands developed under a naturally long fire return interval, they became more uneven-aged and multi-storied as the shade tolerant "climax" species developed. Vertical diversity developed as gaps opened up and shade-tolerant fir advanced. Stands probably tended to look "jumbled up" with complex structure. Reference period density is generally less than what we see today, although not as drastic (on the average) as what has occurred in ponderosa pine types.

Other disturbance factors were probably more significant in the mixed conifer than they were in ponderosa pine. With longer fire return intervals, stands tended to reach target densities desirable to fir engraver and bark beetles. Mistletoes had the time and stand structure to build to heavy levels. Root diseases would not have been present at current levels but would have persisted as opportunists. There would have been much more disease activity in the mixed conifer stands than would have been expected in the ponderosa pine type keeping in mind that much of what we recognize today as mixed conifer, functioned as ponderosa pine during the reference period. This mosaic of ponderosa pine/mixed conifer/fire frequency brought a certain level of resiliency on a landscape scale.

Reference Seral Stage Distribution in the Mixed Conifer Type

Early to Mid (unstocked to small saw timber)	40% (95% single story, 5% multi story)
Late (medium sawtimber and greater)	60% (5% single story, 95% multi story)

Data interpreted from the 1994 REAP Report and the 1947 timber type map.

LODGEPOLE PINE

An extremely variable range of intensities, from minor fire influence to short return interval crown fires characterizes the natural fire regime for high elevation lodgepole pine. The associated fire return frequencies range from 25 to 300+ years. Fires burned on a highly irregular basis with an extremely low degree of predictability. Many lodgepole stands within the Chewaucan basin show no evidence of fire other than starts that went out after growing to less than an acre and in most cases involving only burning down a log.

1. Spatial Arrangement

Unmanaged lodgepole stands today somewhat resemble how they probably looked during the reference period. Lodgepole pine, being a persistent seral species on these sites, shifts to climax white fir very slowly over time. If any change can be described here it is an increase in the fir component within some stand's understory and the fact that the average stand age is older today than it would have been during the reference period.

Lodgepole stands tended to be large and homogenous (less variable within a stand), though at a finer scale exhibited variable degrees of patchiness. This is similar to what can be observed today in unmanaged lodgepole pine although the reference stand probably had the patchy structure more pronounced with more early seral components.

2. Size/Structure

In general, lodgepole pine stands tended to contain a gradient of seral stages mixed within a large homogenous stand. More early and mid seral strata probably existed than the abundant LOS conditions we see today. Bark beetles co-evolved with lodgepole pine and are the same threat today as they always have been, although there is a risk of an outbreak being larger today due to a general increase in the food base (LP > 9" DBH). In fact, evidence shows that mountain pine beetle (MPB) mortality is far more predictable than a fire event was in shaping the lodgepole stands (see "Fire Ecology and the MPB" section of Current Condition Report)(Agee 1993). Dwarf mistletoe is probably more abundant today than during the reference period. What few fires occurred would have put some pressure on serious infection centers. Root diseases may be more prevalent today given an increase in white fir. Reference period stand densities would have been lower due to more early seral components within the stands.

Reference Seral Stage Distribution in the Lodgepole Pine Type

Early to Mid (unstocked to small saw timber)	40% (one to ten acre patches)
Late (medium sawtimber and greater)	60% (all multi story)(see fire & MPB)

Data interpreted from the 1994 REAP Report and the 1947 timber type map.

Non-Forested Uplands

Past management activities such as grazing, road building and fire suppression have changed the range of natural conditions for non-forested vegetation in the watershed. Pioneer settlement in the west is synonymous with the introduction of domestic livestock, which were first introduced in the watershed in the late 1860's. Reference conditions are attributed to a time prior to this settlement. By the late 1800s, the range was overstocked and overgrazed as numerous bands of sheep, cattle, horses and swine grazed these lands relatively uncontrolled until the early part of this century. Extensive sheep operations, common in the early years, have since shifted over to cattle production. By the 1974, all of the sheep allotments within the Sycan watershed had been converted to cattle. Permitted numbers have dropped from nearly 400,000 sheep AUMs and 100,000 cattle AUMs in 1915 to about 70,000 AUMs (cattle) at present for all Forest issued permits. Actual use for the entire Fremont National Forest is somewhere around 50,000 AUMs when considering non-use (Fremont FEIS 1989).

Season long grazing had the most detrimental effects on riparian and meadow vegetation, especially at the lower elevations. The multitude of downcut stream systems and diminished populations of native bluegrasses such as Cusick's bluegrass are evidence of this past abuse. Allotments in the watershed were historically grazed season long. Six allotments are located within the watershed boundary, if only partially: Currier Camp (all but one early season pasture), Bear-Lakes (small portion of West Bear pasture), Paradise Creek (northern portion of allotment), Sycan (southern half of the allotment), Riverbeds (eastern portion adjacent to Sycan River) and Withers Special Use. Currier Camp, and the Bear-Lakes allotments are grazed using a three pasture deferred rotation system. Paradise Creek Allotment has an early season pasture and two pastures that are used in a deferred rotation system. Withers Special Use is a two pasture allotment with deferred grazing. The Sycan River is fenced from grazing during the mid-summer season of use in this pasture. Use in the Sycan Allotment is deferred through herding/riding. Cattle are kept in the lower elevations in the spring and then driven towards Winter Rim to utilize the vegetation as it matures during the season. A portion of the Riverbeds Allotment occupies the western fringe of the Upper Sycan and is grazed season long.

1. Meadow Communities

Bluegrass-dry meadow communities were dominated by cool season native bluegrasses such as Cusick's bluegrass, Sandberg's bluegrass and Nevada bluegrass during reference times. Kentucky bluegrass, a highly competitive, introduced sod-forming grass, has become the dominant grass species in dry meadows once dominated by native bluegrasses.

Conversion of the Kentucky bluegrass dry meadows back to historical conditions does not appear practical under any grazing management strategy, including complete rest. Kentucky bluegrass should be considered naturalized and is expected to remain a dominant species in dry meadow types, even on good condition range (Volland 1985). Dry meadows composed of native bluegrass species were evident in early, mid and late succession in reference times, depending on the degree of natural disturbance, as they were periodically altered by low intensity fires and herbivores. Fire frequency may have been higher for dry meadow systems than other meadow types due to dry surface conditions. Fire reduced litter accumulations, promoted nutrient cycling and limited conifer encroachment.

Hairgrass-sedge-moist meadows were dominated by all native species such as tufted hairgrass and sedges, similar to what is present today. However, a non-native species such as meadow foxtail and redtop, which are found in some moist meadows today, would not have been present. Fire influenced these higher elevation meadows on a low frequency scale. Moist meadows would have been in mid to late seral stages, similar to current conditions.

Sedge-wet meadows were dominated by wetland sedges and trace amounts of hairgrass. Fire had a restricted role in maintaining wet meadows due to their high water tables. Periodic late fall burns reduced litter or thatch. These "boggy" sites were late successional due to infrequent disturbance. Species composition was similar to current conditions.

The predicted fire frequency for all meadow systems in the watershed is directly tied to the type of forested vegetation surrounding the meadow where natural or lightening caused fire would ignite. Varying fire intervals in forested associations acted to limit forest succession on the edges of meadows to maintain distinct forest-meadow boundaries. Fire may not have occurred in years of normal to above normal precipitation; however, drought years, which cured the herbaceous vegetation, increased fire frequency considerably. Pine seedlings tended to establish on the meadow periphery in years of low snowpack and early melt-off, however, these conditions favored the likelihood of fire. Meadow encroachment by conifers was cyclical. Historic burning by herdsmen also influenced fire occurrence. Livestock grazing and suppression efforts beginning at the turn of the century reduced natural fire incidence. Fire incidence is expected to be higher for the surrounding watershed than for a particular meadow site due to factors such as fuel moisture. Forested vegetation is expected to burn more frequently due to drier fuel conditions where a direct burn in a meadow was less common. The effect of fire on meadow composition varies with the intensity and depth of burning. At the watershed scale, fire had the effect of increasing sediment and water flows and influencing meadow evolution and ecology (Ratliff 1985).

2. Shrub/Bunchgrass Communities

Sagebrush steppe communities of the Intermountain West were also maintained by periodic fire (Miller 1997). Sagebrush plant associations were found adjacent to the edges of meadows and buffered between timber types. Low sagebrush/fescue-squirreltail communities were found in scablands and areas with restrictive soil depths. A majority were found in mid-late succession in reference times, with few early seral stands represented due to the low fire frequency of these communities. Low sagebrush sites have shallow soils and low herbaceous plant productivity that limited fire to 100-200 year cycles. Dispersed old growth (>150 years old) juniper were present in this type.

Mature stands of big sagebrush/bunchgrass represented climax or near climax conditions. Big sagebrush sites were once dominated by bunchgrasses and forbs due to more frequent fire events (every 12-20 years) keeping a mosaic of these communities in early succession. Due to natural disturbance regimes, conifers did not generally grade into shrub communities. The big sagebrush/bitterbrush/fescue type has shifted to a more even-age shrub community that is a concern in regards to forage production and wildlife habitat needs. In reference times, differing age classes and plant community structure would have been present for all shrublands.

3. Juniper Communities

Periodic fires and drought kept western juniper restricted to rocky hillsides, ridges and outcrops, historically. Few juniper would have been found in either low sagebrush/fescue/squirreltail or big sagebrush/bunchgrass communities. The low sagebrush/fescue/squirreltail association would have had less than 2-4 trees per/acre and 0-4 trees/acre were found in big sagebrush/bunchgrass communities (Hopkins 1979). Juniper expansion out of juniper/ low sagebrush/fescue communities began in the mid 1880's (Miller 1997), however its expansion is limited to several communities such as the low/sagebrush/fescue-squirreltail and expansion within and outside of the ponderosa pine/juniper/mountain mahogany-

bitterbrush-big sagebrush/fescue communities. Past overgrazing set the stage for initial juniper expansion by reducing herbaceous ground cover, competition and fuels necessary to carry fire.

4. Open Forest Communities

The forested plant communities in the watershed that provide a forage base for domestic livestock, such as Ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue, Ponderosa pine/bitterbrush/fescue, Ponderosa pine/bitterbrush-manzanita/fescue, Ponderosa pine-Quaking aspen/bluegrass and Ponderosa pine/mountain big sagebrush/bluegrass associations, were maintained by a natural fire regime during the reference period. Historic fire regimes maintained understory vegetation in early to mid seral condition, while maintaining old growth overstory characteristics. Ponderosa pine communities were more open and "park-like". Low intensity fire kept pine seedlings and sagebrush from reaching a mature stature and maintained a herbaceous understory.

Aspen communities were naturally maintained by fire, which limited conifer encroachment and promoted vegetative regeneration. In reference times, aspen communities were most likely found in various un-even aged patches with active regeneration stimulated by fire, beaver activity and other natural disturbance regimes. Conifer encroachment into aspen stands would have been a minor issue in reference times.

Noxious Weeds

Noxious weeds are defined in the Fremont Land and Resource Management Plan as " undesirable plant species that are unwholesome to the range or to animals ". The introduction and establishment of undesirable species was often related to activities associated with European settlement. Since these activities were not prevalent until the late 1860s, it is appropriate to consider that the exotic, noxious weeds currently found in the watershed were not present in reference times. Native plants that were undesirable to animals and/or humans may have been present, but again would not have been considered noxious by the current definitions and standards.

Threatened, Endangered, and Sensitive Plant Species

Reference condition, dating sometime before the 1860s, refers to the time prior to the activities of European settlement in the area. Given this historical perspective, the plant communities in the basin were considered functional and intact within an expected realm of natural ecological variation. Anthropogenic fires and plant cultivation were considered part of the natural landscape cycle. Therefore, no threatened, endangered or sensitive plant species would have been identified.

Blue-leaved penstemon populations, which are adapted to natural disturbance in the lodgepole pine forest type, were more than likely represented in the early to mid seral succession lodgepole pine forests in reference times. As the overstory canopy closes in, habitat quality for blue-leaved penstemon declines. Clearcutting practices of the past have created more habitat for this plant than was present in reference times, therefore it is estimated that there is more blue-leaved penstemon today than what was present historically. Green tinged paintbrush is found in association with ponderosa pine/mountain big sagebrush plant communities. Open ponderosa pine stands historically had low intensity fire cycles that prevented canopy closure and kept sagebrush and other shrub species in check. Green-tinged paintbrush has adapted to the maintenance of these open pine/sagebrush communities, which is considered optimal habitat for this plant. This plant is present in range and abundance similar to reference conditions.

III. Terrestrial Species and Habitat

Key Questions:

1. How have wildlife abundance, distribution, diversity and habitat conditions been altered?

2. What key terrestrial habitat components are scarcest or most at risk? What threatens species viability?

3. Where are the known problem areas that are contributing to reduced wildlife habitat capability?

Threatened, Endangered, and Sensitive Species

1. Northern Bald Eagle (Threatened, Proposed for De-listing)

No historic information on bald eagle abundance and distribution exists. Nesting and roosting habitat was probably more abundant and of higher quality prior to 1945. The predominance of late and old seral ponderosa pine in open parklike stands provided preferred nest/roost sites and were relatively stable and resistant to catastrophic wildfire. Habitat security for eagles and prey populations was high due to low road densities and lower incidence of human use.

2. American Peregrine Falcon (R-6 Regional Forester's Sensitive Species List; recently De-listed from Endangered)

No historic peregrine sightings or nest sites are recorded in the watershed. Six cliff sites classified as potential nesting habitat may or may not have been occupied historically. The quality and quantity of nesting habitat was probably similar to that which occurs presently. The predominance of LOS open, parklike ponderosa pine stands provided only fair to marginal habitat for prey species. Habitat security was higher due to low road densities and lower incidence of human use.

3. California Bighorn Sheep (R-6 Regional Forester's Sensitive Species List)

No presettlement or historic information on California bighorn sheep exists. However, Native American rock drawings in the area depict representations of bighorn sheep and it is believed that bighorns occupied the area during this time period. The predominance of open, parklike LOS ponderosa pine stands and grass/forb communities associated with frequent, low intensity wildfire probably provided ideal habitat conditions for bighorn sheep where adequate water and escape terrain existed.

4. Greater Sandhill Crane (R-6 Regional Forester's Sensitive Species List)

No information on historic sandhill crane distribution exists for the Upper Sycan Watershed. Sandhill crane habitat quality, quantity, and security were probably greater prior to the onset of heavy grazing from 1870 to 1945. Juniper and other conifer encroachment into meadow systems with the advent of fire suppression early in this century further accelerated the decline of sandhill crane habitat.

5. Western Sage Grouse (R-6 Regional Forester's Sensitive Species List)

No information on historic grouse distribution, lek location or habitat condition is available for the watershed. The only historic grouse information available for the Fremont National Forest is for the period 1938 through 1941 when 400 - 1,600 grouse were estimated to occur on the Forest. Grouse habitat quality, quantity, and security significantly declined with the

onset of heavy grazing in both upland and riparian areas from 1870 - 1945. High deer numbers on sagebrush ranges beginning around 1930 and wildfire suppression leading to juniper encroachment into sagebrush habitats accelerated the decline of preferred grouse habitat.

Keystone and Other Terrestrial Species

1. Big Game

Historical accounts of the Interstate and Silver Lake mule deer herds describe herds as being small and scattered in the early 1900's. About 1930, deer numbers began to increase. By the mid 1940's range damage due to deer overuse was noted. The Interstate Herd was estimated at 14,000 to 14,600 deer in 1946. The Siler Lake herd was estimated at 12,500 in 1959. Reasons for the increase beginning in 1930 are not clear, but contributing factors probably include predator reductions, decreases in cattle and sheep grazing, weather variations, protection from hunting, and shifts in the fire regime leading to increased production of shrubby forage. Seasonal distribution of deer was most likely similar to what occurs today as deer traditionally use the same seasonal ranges over time.

Prior to 1870, deer ranges in lower elevations were probably dominated by bunchgrasses with scattered or clumpy distribution of shrubs. Distribution and density of both curl leaf mountain mahogany and bitterbrush were less than what they are currently. Heavy livestock grazing and later fire suppression combined to gradually increase shrub densities on all seasonal ranges. Consequently browse conditions increased in quality and quantity. By the 1930s and 1940s, deer numbers had increased to a point exceeding carrying capacity on most ranges and forage conditions began to degrade. Poor forage conditions on seasonal ranges were reported in the early 1940s.

Hiding cover prior to 1870 was probably adequate in most areas above 5,500 feet elevation, and poor over much of the range below 5,500 feet where more open ponderosa pine stands dominated. Fire suppression during the twentieth century has resulted in dense stands of mixed conifer and regeneration thickets of ponderosa pine increasing available hiding and thermal cover.

No presettlement or historic information on elk population numbers or seasonal distribution in the watershed is available. Annual wildlife reports for the Fremont National Forest from 1926 - 1933 show no elk present on the Forest. Ten elk were reported on the Forest for the period from 1943 - 1945. Prior to 1980, no recreational hunting of elk was allowed in Lake County due to the low population numbers.

2. Beaver

No assessment of beaver populations prior to 1935 is available; however, beaver were undoubtedly more plentiful prior to Euro-American settlement. Fur trapping in the 18th and 19th centuries decimated beaver populations throughout the west. The effects of heavy livestock grazing from 1870 to 1945 and later fire suppression on riparian deciduous vegetation adversely affected the quality and quantity of beaver habitat.

3. Other Terrestrial Species

No non-game or Neotropical migrant bird species assessments are available for the period prior to 1945. However, wildlife species dependent on sagebrush stands with a diverse grass and forb understory, riparian area dependent species, and species favoring open, parklike stands of ponderosa pine undoubtedly had more suitable habitat conditions prior to Euro-American settlement and eventual introduction of livestock grazing and suppression of fire.

Management Indicator Species Associated with Late and Old (LOS) Forest Cover

1. General

The abundance, distribution, connectivity, and quality of suitable habitat for management indicator and other wildlife species associated with dead wood and LOS forest habitats was significantly greater during the period prior to 1947 than what exists under current conditions. The landscape below 5,500 feet elevation was dominated primarily by a contiguous late/old seral ponderosa pine forest. A lesser area of LOS mixed conifer forest occurred at the higher elevations, predominately above 5,500 feet, but outside areas dominated by lodgepole pine. Average, maximum, and range of patch sizes were large and most of the patches were of high quality interior habitat unaffected by edge. Large diameter live trees, snags, and down wood were probably more common on average than what currently exists. Late/old seral lodgepole pine probably existed only rarely as large area blocks because stands were constantly broken down by insect outbreaks and regenerated by stand replacing fires.

Gaps and fragmentation occurred which normally consisted of areas of insect outbreak, burns and natural openings, but overall fragmentation was much less than under current conditions. The contiguous forest matrix facilitated species dispersal, colonization, and genetic interchange throughout the watershed. Management indicator and other species, especially those associated with LOS open ponderosa pine conditions, were undoubtedly more numerous due to the abundance of suitable habitat. The exceptions may be the pileated woodpecker and pine marten, which have benefited from the increase in densities and multi-storied forest.

2. Northern Goshawk

Nesting habitat conditions were more suitable prior to 1945 when contiguous open LOS forest matrix and interior habitat dominated the landscape. The preponderance of open, parklike ponderosa pine LOS forest cover and more area in mature aspen clones provided a greater abundance of and more suitable habitat conditions for goshawk nesting. A greater abundance of prey species associated with LOS forest cover and dead wood would have been present, especially species associated with the high cone production characteristic of open, large tree ponderosa pine forest. The smaller scale horizontal and vertical structural diversity created from natural disturbance within the forested landscape provided diverse habitat for prey species at more of a micro scale than the macro scale regeneration units present today. Younger stands of lodgepole pine were less suitable goshawk habitat than the more abundant LOS stand structure seen presently. Habitat security would have been relatively high with lower road densities and less incidence of human use or timber harvest activity.

3. Pileated Woodpecker

Pileated woodpecker habitat prior to 1945 was more extensive and contiguous throughout the watershed, but was probably somewhat less suitable than what presently exists. Forest cover dominated by more open parklike, single story LOS ponderosa pine lacked the structural complexity (down logs, dense canopy, and snags) and densities of the more suitable forest cover (mixed conifer) that provides preferred pileated woodpecker habitat. Highly suitable habitat, however, would have existed above 5,500 feet in areas dominated by mixed conifer where large contiguous blocks of mixed conifer LOS with snag and down wood components intact were likely prevalent.

4. American Marten

The only known historic records of marten on the Fremont National Forest are shown below.

Year	Numbers
1929	300
1939	240
1940-45	300

Marten habitat prior to 1945 was more extensive and contiguous throughout the watershed, particularly in the upper elevations of the watershed, but was less suitable than present conditions. Forest cover dominated by more open parklike, single story LOS ponderosa pine and younger stands of lodgepole pine lacked the structural complexity (down logs, multi-storied canopy, and snags) and moist site conditions that provide preferred marten habitat. Also, habitat conditions for prey species associated with riparian areas deteriorated significantly between 1870 and 1945.

5. Black-backed/Three-toed Woodpecker

There is no black-backed, three-toed woodpecker information available for lands within the watershed for the period prior to 1945. Habitat conditions for black-backed and three-toed woodpeckers were likely less suitable at the turn of the century than what existed 50 years ago and what currently exists. The lack of large blocks of mature lodgepole pine would have created marginal home ranges for this species on a long-term basis. The more prevalent, younger lodgepole pine stands lacked the snag and down wood densities characteristic of older stands present today. However, periodic large fires, disease or insect infestations that swept through stands of lodgepole pine would have created ideal short term foraging conditions, distribution and abundance of these birds would have shifted relatively often in response to these events. The single story, parklike LOS ponderosa pine stands that dominated the landscape provided suitable habitat except snag habitat was less prevalent due to the healthier forest conditions. Populations of black-backs were probably smaller in numbers, more stable, and less irruptive than what currently exist.

Dead Wood Habitat Management Indicator Species (MIS)

1. Primary Excavators

No historical information is available on the occurrence of primary excavators in the Upper Sycan Watershed. It can be speculated however, that primary excavator habitat (snag and down wood) was more extensive and contiguous throughout the watershed, but was probably somewhat less suitable than what presently exists. Forest cover dominated by more open parklike, single story LOS ponderosa pine stands in relatively good health would generate less snag and down wood habitat. Snags and down woody material was larger and less abundant than current conditions. Snag habitat may also have consisted of a greater amount of large trees with dead (spike) tops. Excavator species associated with open, late and old ponderosa pine forest cover, such as white-headed and Lewis woodpeckers, would have had more ideal habitat conditions and their distribution and abundance may have been greater than that seen presently.

Aspen/Deciduous Riparian Habitat (MIS)

1. Red-naped Sapsucker

No historical information is available on the occurrence of aspen forest over the landscape. However, it can be speculated that with more frequent, low intensity and larger, high intensity wildfires, lower coniferous stand densities, and higher water tables along riparian areas, the abundance, distribution and successful regeneration of aspen clones was likely greater prior to the era of fire suppression, heavy livestock grazing and high deer numbers during the first half of this century.

More aspen in a diversity of age classes and distribution over a larger area would have provided more available and suitable habitat conditions for aspen associated wildlife species, including the red-naped sapsucker. As aspen distribution decreased across the landscape, populations and distributions of aspen associated species also declined.

IV. Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

Prehistory

The known physical evidence of human occupation within the Upper Sycan Watershed basin boundaries indicates that humans began to move into the area about 10,000 years ago to extract and utilize the natural resources found there.

Downstream from the Upper Sycan basin is the vast, open Sycan Marsh. This area of abundant natural resources (plants and animals) was central and primary to the aboriginal people and the focus of their activities in the seasonal round of resource extraction. The Upper Sycan flows through National Forest system lands, enters the Sycan Marsh which is privately owned by the Nature Conservancy and presently leased by the ZX Ranch and then re-enters National Forest system lands to continue on its journey to the Sprague River system. Numerous archaeological sites are found in the Sycan Marsh.

Archaeological sites found at the higher elevations adjacent to the Upper Sycan drainage are usually small, seasonal, multi-purpose hunting and gathering sites to the early inhabitants. The area near the Marsh was probably a seasonal, semi-permanent village site.

From there, they would have moved into the forest and up-country to hunt and gather on a seasonal scheme. For thousands of years these people focused on the abundant resources of the Sycan Marsh. The same plants, to a lesser degree, matured much later in the season in the Upper Sycan basin as compared to the Sycan Marsh, which gave the local inhabitants a sustainable source of food with abundant periods of production.

The few small upland lithic scatter sites were probably related at times to the few much larger complex habitation sites located in the Sycan Marsh. This scheme of seasonal migration and resource extraction probably continued for 8,000 to 10,000 years or more until the Euro-American people started to move into the area about 150 years ago. This seasonal gathering, hunting and migration of the aboriginal peoples had little to no impact on the landscape.

Digging roots in the meadows only increased the meadow's productivity and any fires were allowed to burn to manipulate and revitalize the vegetation found across the forests and open lands. Adjacent to these mostly utilitarian sites, there were some sites of ceremonial and/or religious nature. These sites are very sensitive and their physical remains are more subtle than the many lithic scatters found in the area.

The archaeological sites known to exist in the sub-basin have been evaluated and continue to be included in ongoing archaeological research in the area.

History

The Upper Sycan Watershed was a seasonal hunting and gathering area to the native populations. To the early white settlers it was an abundant natural resource area for exploitation. The first white people were probably trappers, traders and

mountain men looking for gold and beaver. As homesteads began to be built at the lower elevations, the newly introduced cattle, horses, sheep, goats and swine from the central farm locations moved up into the mountains during the summer months following green-up of grasses and other vegetation. People would follow and spend time with their livestock and over time set up line shacks and homesteads in these higher elevation areas. By the turn of the century, there were a half dozen such locations in and around the watershed.

1. Timber

Prior to World War II the harvesting of timber was of a limited nature and on a small scale. However, one of the first visible impacts to the landscape occurred with the advent of logging. Lumber markets grew from local to regional at the end of the reference period.

2. Grazing

Prior to Euro-American settlement, there was no livestock grazing except for possible wild horse herds. During the time between the first homesteaders (1870s) and the 1940s, when many small homesteads were started within the watershed, there were still large areas of public land, which was used in common. Fifty years ago there were both active and abandoned homesteads scattered throughout the watershed. Following the Taylor Grazing Act in 1934, grazing districts were formed and allotments were established.

Even though livestock numbers peaked in the early decades of this century, not until the end of the reference period was considerable effort made to manage livestock grazing. Reduced stocking levels and the initiation of range improvements were major tasks of the Forest Service at this time. Beginning during the first decade of the century to about 1930, Forest-wide sheep numbers went from 120,000 to about 80,000. This effort to reduce sheep numbers Forest-wide was also seen in the watershed. Cattle and horse head numbers were reduced from 26,000 to about 10,000. Although these large numbers of animals had a definite impact on the condition of the forest's grasses and shrubs, it was the long grazing season that had the most detrimental effect. During low snow years, such as the 1930's, livestock were basically left on the Forest year-round. More typically, season-long grazing extended up to eight months.

Early accounts by stockmen reflect that much of the watershed had open stands of ponderosa pine with a herbaceous understory making cattle movement easier and exceptionally open views readily available. Fire suppression has resulted in an increase in understory trees and shrubs. At the turn of the century, common use by all classes of livestock such as cattle, sheep, horses and swine was evident in the watershed. Records indicate that sheep grazed the watershed as permitted livestock after the establishment of the Fremont National Forest in 1907 up until the 1940's. However, trespass use by cattle and horses was common and led to problems with heavy use on the range. A drift fence, constructed in 1927, separated the Chewaucan Cattle & Horse Allotment and the Sycan Sheep & Goat Allotment and to help reduce trespass use. Trespass use, mainly by horses drifting over from the Klamath Indian Reservation remained a problem. The Weyerhaeuser Company at one time owned the large block of private land in the north central portion of the watershed. Weyerhaeuser leased their holdings to permittees to graze sheep up until the early 1940's, when the shift was made to the management of cattle grazing on these lands, which continues to this day through private land leases administered by U.S. Timberlands Company.

STEP 5. SYNTHESIS AND INTERPRETATION

The purpose of Step 5 is to compare current and reference conditions of specific ecosystem elements and to explain significant differences, similarities, or trends - and their causes. Information from the previous four steps is interpreted. The interactions of biological, physical and social processes are explained. The capability of the system to achieve key management plan (Fremont LRMP) objects is discussed.

I. Watershed and Aquatics

The main purpose of this chapter is to address the four key questions by summarizing current conditions within the entire watershed, then comparing these conditions with the desired conditions described in Step 4. For each element, ratings will be given (see desired conditions for ratings) along with a discussion of the factors contributing to current conditions as well as any trends in conditions.

Uplands

Key Question 1): Is the upland portion of the watershed/subwatershed producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas?

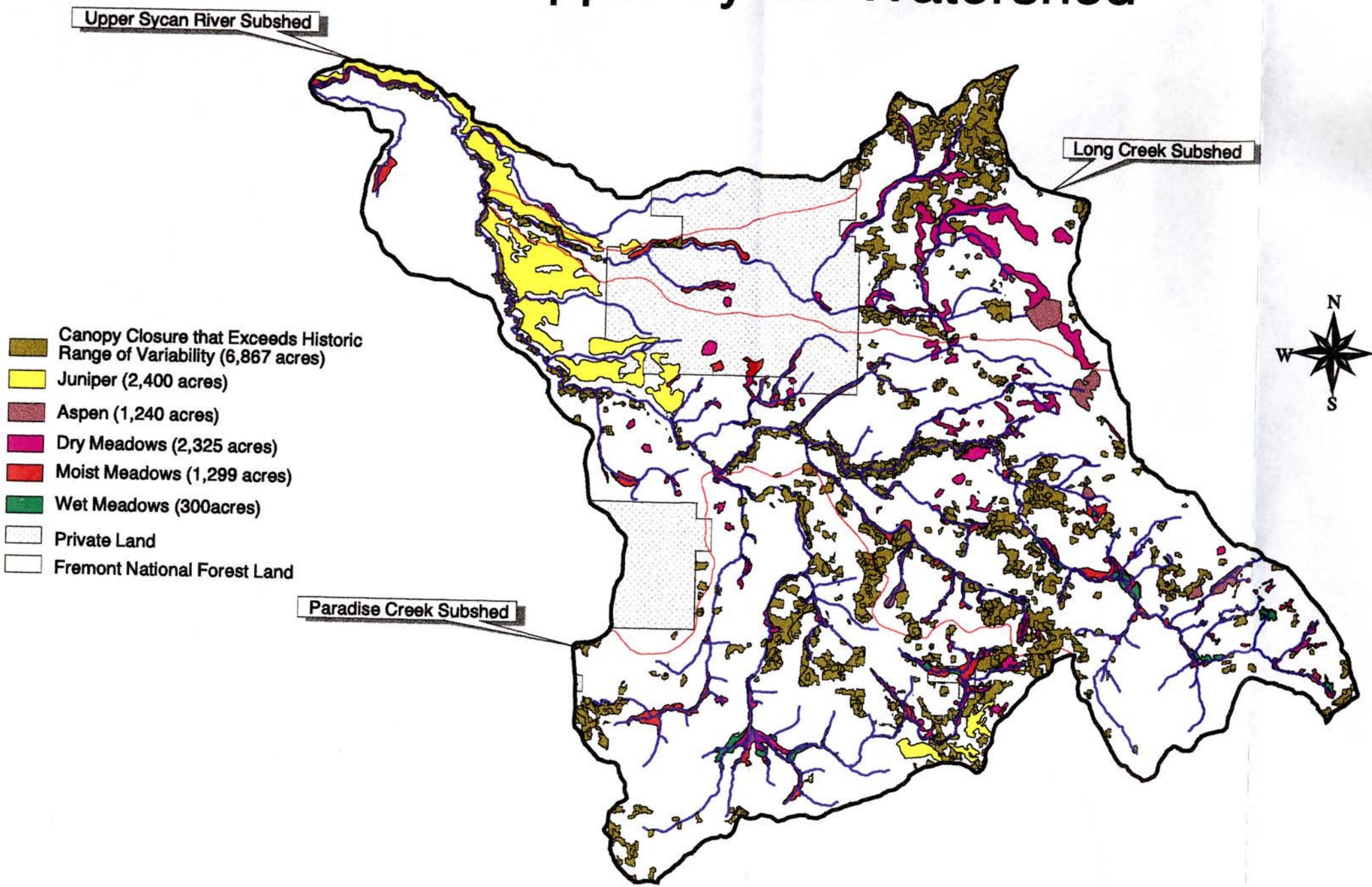
1. Upland Plant Communities and their Effect on the Amount of Water and Sediment Reaching Riparian Areas

Within the 65,700 acre watershed, forested land covers 54,700 acres, approximately 83% of the watershed. The frequent and low intensity ground fires that maintained vast stands of open ponderosa pine forests have been suppressed since the early 1900's. This has created conditions that allow conifers to grow in greater densities than occurred historically in both forested and meadow sites. Of the forested acres, 13% or 7,000 acres have canopy densities exceeding the Historical Range of Variability (HRV). Refer to Figure 5.1 - Upper Sycan River Watershed Upland Vegetation. As mentioned in the previous chapter (Desired Conditions), when less than 50% of forested communities are outside recommended canopy closures, the forest stands are either functioning appropriately or functioning appropriately but-at-risk. All of the individual subwatersheds are below 18%.

In addition, past silvicultural treatments emphasized either clear-cutting of lodgepole and ponderosa pine or selective removal of individual large ponderosa pine. Because these treatments were not based on maintaining forested stands within their HRV, they are a contributing factor to current conditions. The seedling/sapling stands are a result of forested areas that were harvested through clear-cutting, shelterwood, and seed-tree silvicultural prescriptions. Approximately 12% (6,400 acres) of the forested lands within the watershed are in openings--mainly as seedling/sapling sites--which is below the 20% recommendation for the Upper Sycan Watershed and the 20-30% figure noted by Troendle (1982), the point where a significant change in flow can be detected. As mentioned in the previous chapter (Desired Conditions), when less than 20% of forested lands are in openings (early seral condition), the forest stands are considered to be functioning appropriately. One of the subwatersheds, Paradise Creek, has approximately 25% of its forested lands in openings, which falls into the functioning appropriately but-at-risk category. The other two subwatersheds (Long Creek and Sycan River) are less than 20%.

In summary, fire suppression over the last 100 years has allowed young conifers to grow in higher densities than occurred historically. This build up of understory trees heightens the risk of catastrophic fire, and may cause trees to become stressed and susceptible to insects, disease, and density-related mortality. Conifers have also expanded into many of the dry and moist meadows and riparian areas throughout the watershed, promoting competition with riparian vegetation--willows, aspen, cottonwood, and alder--necessary to maintain proper stream types and bank stability. In the western portion of the

Fig. 5.1 Upland Vegetation in the Upper Sycan Watershed



watershed, junipers are slowly expanding into the drier, deeper-soil pine +sites. All of these factors may be contributing to lower base flows within the watershed, but the extent is unknown. Additionally, the effect of management activities on soil resources has been fairly extensive throughout the watershed, a result of past timber harvest activities. Associated with these activities were silvicultural treatments that moved forest stands away from HRV. For these reasons, this element receives a **functioning appropriately but-at-risk** rating for the watershed as a whole, and for each individual subwatershed.

2. Road Density, Location, and Drainage Network

There are 296 miles of roads within the 65,700 acre watershed, most of which were constructed to provide access for recreation and the vast timber resources within the area. This results in a road density of 2.9 mi/mi², and consequently the watershed is **functioning appropriately but-at-risk**. Refer to Figure 5.2 - Upper Sycan Watershed Road Locations. All three subwatersheds have similar road densities, all less than 3.1 mi/mi², well below the high end of the **functioning appropriately but-at-risk** range. Along with the 170 miles of stream channels within the watershed, an estimated 178 of the 296 miles of roads are hydrologically integrated with the stream network, thus increasing the drainage network by 104%--based on Wemple's (1994) study results. Two of the subwatersheds have increased drainage networks that exceed this value--Paradise Creek (105%) and Long Creek (138%). The remaining subwatershed is below this value—Sycan River (96%).

The limited stream gage data available for the Upper Sycan River Watershed indicates that annual peak discharge is dominated by runoff from spring snowmelt with peaks occurring in April and May, although instantaneous peak flows can occur as a result of rain on snow events in December and January. The lack of long-term stream flow data (limited to the last six years) precludes analysis of changes in stream flows due to land management activities within the analysis area. However, current literature suggests that land management activities--like those that have occurred in the Upper Sycan River Watershed--may alter the timing, magnitude, and frequency of peak flows. In order to see if a similar suggestion could be made locally, data from a nearby watershed with extensive stream flow records, the Upper Chewaucan River Watershed, were analyzed. Analysis of this data does seem to suggest that the effects of land management activities (increased drainage network from roads and detrimental soil compaction) have increased the number of days the Chewaucan River exceeds bankfull flows. Table 5.1 displays the comparison of data summarized from the gauging station on the Chewaucan River during the periods of 1926-1945 (the time period of record prior to extensive road building and timber harvesting activities) and 1946-1989 (the period during, and after, extensive road building and timber harvesting activities). This table displays that the number of days the river exceeds bankfull stage is significantly higher during the latter period of time.

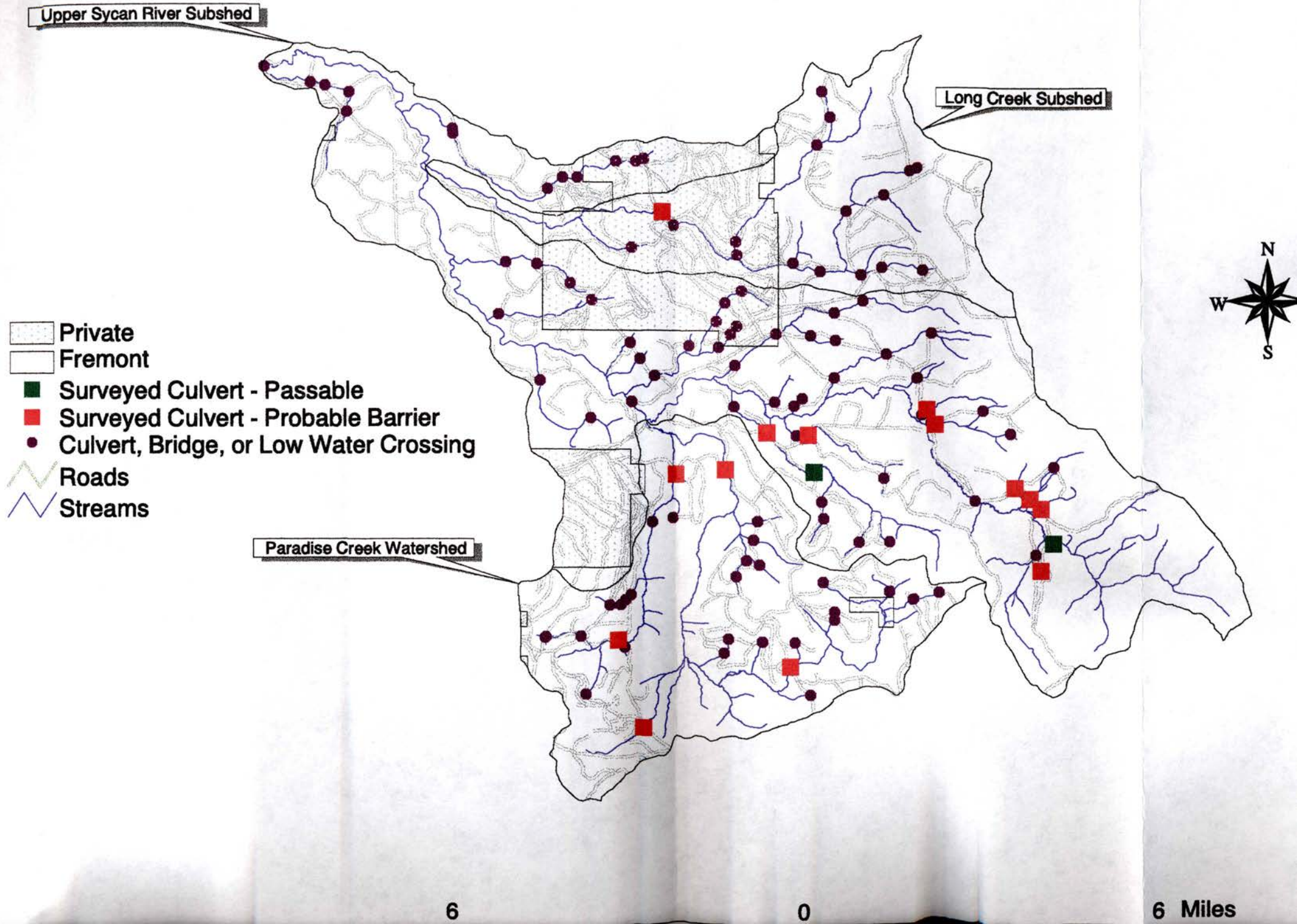
Table 5.1 - Bankfull flows for Average Precipitation Years on the Chewaucan River.

Year	Precipitation (Average)	Days per Year within the Range of 80% to 120% Bankfull (Average)	Days per year exceeding 120% Bankfull (Average)	Days per year exceeding Bankfull (Average)
1926-1945	14.91	22	1	8
1946-1989	14.89	18	12	20

This information is included since the road densities, as well as levels of past timber harvesting activities, in the Upper Sycan River Watershed are quite similar to those in the Upper Chewaucan. Thus, it is believed that the effects of the increased drainage network throughout the Upper Sycan River Watershed, from roads and detrimental soil compaction, have modified the timing, magnitude, and frequency of peak flows, but the extent is unknown.

Besides altering peak flows, roads also increase sediment delivery into streams. Of the 296 miles of roads, 34 (12%) are within 300 feet of perennial and intermittent streams. Furthermore, roads cross channels at 119 locations--sites where direct sediment introduction occurs. Based on the weighted average for the three subwatersheds, the Road Impact Index was calculated to be 0.49. Road Impact Index numbers were greater than the average in only one of the three subwatersheds--Sycan River (0.64). The remaining two subwatersheds are below the average--Paradise Creek (0.35), and Long Creek (0.18). As stated in Chapter 4 (Desired Conditions), the Road Impact Index is an indicator of sediment delivery risk associated with road density and the number of stream crossings - see page (3-3).

Fig. 5.2 Road Locations, Stream Crossings, and Surveyed Culverts in the Upper Sycan Watershed



Riparian Vegetation and Stream Channels

Key Question 2): Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

1. Riparian Vegetation and Associated Bank Stability

Paradise Creek Subwatershed: The following tables (Tables 5.2, 5.3, and 5.4) summarize current and desired conditions for vegetation types and associated bank stability within riparian areas of Paradise, Crazy, and Watson Creeks. Ratings given within these tables are based on a comparison of current and desired conditions (see desired conditions in Chapter 4 for ratings) within each of the surveyed stream reaches. Following each table is a discussion of these ratings and the factors contributing to current conditions, as well as any trends in conditions. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

Paradise Creek

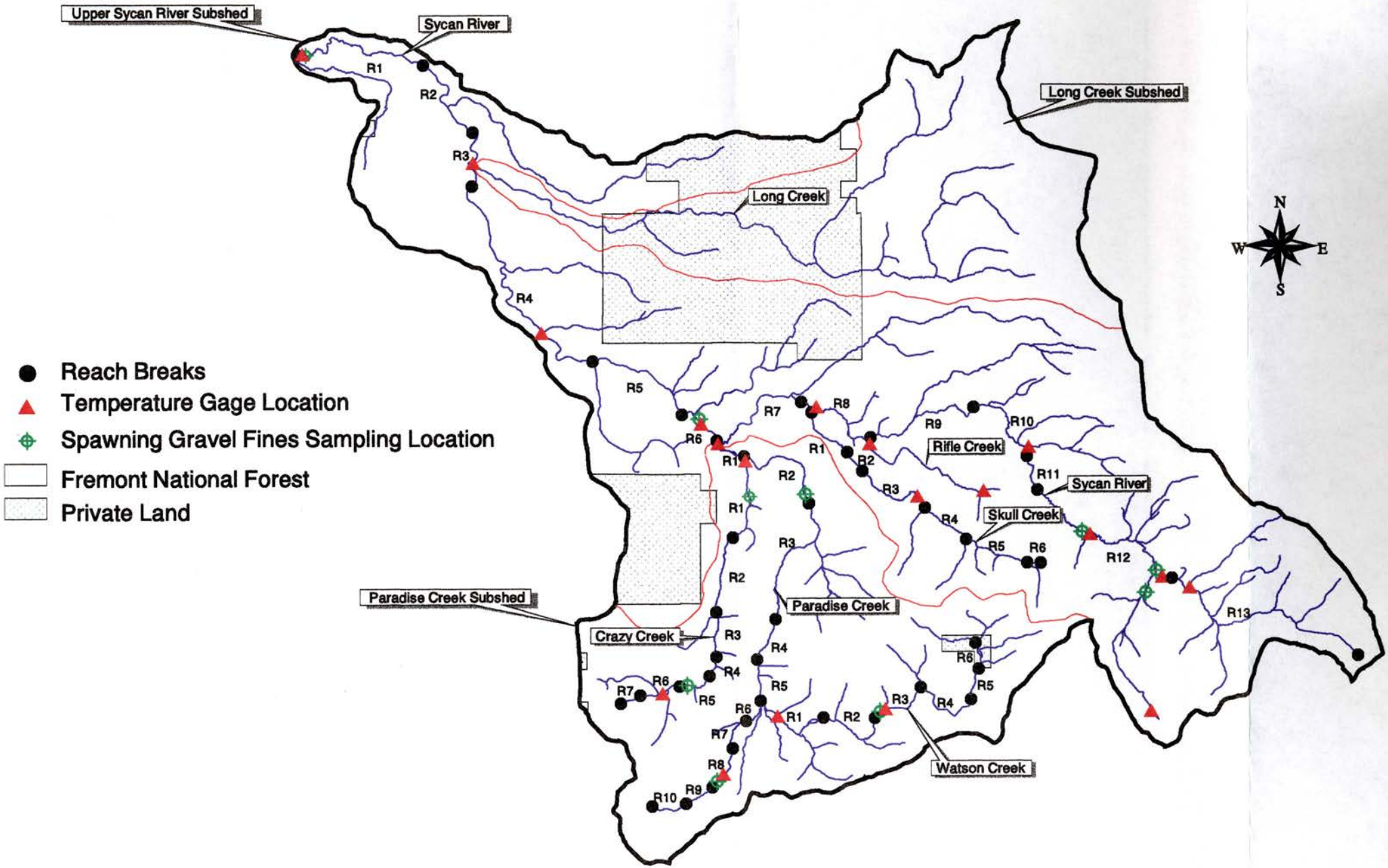
Table 5.2. Paradise Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Condition	Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
						Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	0.7	USFS	9	1	1 Desired	SE	HW 1-4	GR	GR	CL 3	GR	>90
					1 Current	SE	HW 1-2	GR	CL 1	CL 3	GR	91
					1 Rating	Functioning Appropriately						
2	2.1	USFS	13	2-4	2 Desired	SE	HW 1-4	CL 2-3	GR	CL 3	GR	>90
					2 Current	SE	HW 2-4	CL 2-3	GR	CL 3	GR	95
					2 Rating	Functioning Appropriately						
3	2.0	USFS	11	1	3 Desired	SE	HW 1-4	GR	CL 2-3	CL 3	GR	>90
					3 Current	SE	GR	CL 1	HW 1	CL 3	GR	93
					3 Rating	Functioning Appropriately but-at-Risk						
4	0.6	USFS	12	1	4 Desired	SE	HW 1-4	GR	CL 2-3	CL 3	GR	>90
					4 Current	SE	GR	HW 1-2	CL 1-2	CL 3	GR	98
					4 Rating	Functioning Appropriately but-at-Risk						
5	0.8	USFS	4	1	5 Desired	SE	HW 1-4	GR	SS 1	GR	SS 1	>90
					5 Current	SE	HW 1	GR	SS 1	SS 1	GR	93
					5 Rating	Functioning Appropriately but-at-Risk						
6	0.4	Private	3	<1	6 Desired	SE	HW 1-4	GR	SS 1	GR	SS 1	>90
					6 Current	SE	GR	HW 1	SS 1	SS 1	GR	74
					6 Rating	Functioning Inappropriately						
7	0.7	USFS	3	<2	7 Desired	SE	HW 1-4	GR	SS 1	GR	SS 1	>90
					7 Current	SE	HW 1-2	GR	SS 1	SS 1	GR	77
					7 Rating	Functioning Inappropriately						
8	1.2	USFS	4	4	8 Desired	SE	HW 1-2	GR	CL 2-3	CL 3	GR	>90
					8 Current	SE	HW 1-2	GR	CL 2-3	CL 3	GR	91
					8 Rating	Functioning Appropriately						
9	0.5	USFS	4	8	9 Desired	SE	GR	HW 1-2	CL 2-3	CL 2-3	GR	>90
					9 Current	SE	GR	HW 1-2	CL 2-3	CL 2-3	GR	96
					9 Rating	Functioning Appropriately						

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

The dominant plant types--sedge and willow--along reaches 1 and 2 are highly similar to late seral species composition, resulting in high bank stability values. For these reasons, reaches 1 and 2 are **functioning appropriately**. Although bank stability values exceed 93%, Reaches 3 through 5 are **functioning appropriately but-at-risk** due to an abundance of grass and a lack of willows in all age classes. In reaches 6 and 7 sedge and grass are dominants but bank stability is 74% and 77%, respectively, thus both are **functioning inappropriately**. Again, a contributing factor to these conditions is a lack of willow

Fig. 5.3 Reach and Monitoring Locations in the Upper Sycan Watershed



in all age classes. Reaches 8 and 9 are **functioning appropriately** due to a dominance of late-seral species and bank stability being greater than 91%.

Naturally stable stream types (Refer to Rosgen channel type discussion) and the dominance of late-seral species in reaches 2, 8 and 9, promote the high bank stability values. Past livestock practices have influenced bank stability and vegetative conditions, especially the lack of willow, throughout the low-gradient meadow portions of reaches 3-7. Grazing strategies were changed in 1995 with all reaches being in a pasture that is part of a deferred-rotation system (early use one year, then later use the next). It appears that riparian conditions have improved since this grazing management change occurred. An additional factor affecting bank stability within this stream might be the increased drainage network associated with roads throughout the subwatershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

Crazy Creek

Table 5.3. Crazy Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Condition	Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
						Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	1.7	USFS	5	3	1 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	CP 2-4	>90
					1 Current	SE	GR	HW 1-4	CL 1-3	CL 1-3	CP 1-3	99
					1 Rating	Functioning Appropriately						
2	1.4	USFS	5	1	2 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	CP 2-4	>90
					2 Current	SE	GR	CL 1-3	HW 1-3	CL 1-3	CP 1-3	96
					2 Rating	Functioning Appropriately						
3	0.8	USFS	5	1	3 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	SS 1	>90
					3 Current	SE	GR	HW 1-4	CL 1-3	CL 1-3	SS 1	97
					3 Rating	Functioning Appropriately						
4	0.6	USFS	4	1	4 Desired	SE	GR	HW 1-4	SS 1	CL 2-3	SS 1	>90
					4 Current	SE	GR	HW 1-4	SS 1	CL 1-3	SS 1	99
					4 Rating	Functioning Appropriately						
5	0.9	USFS	4	1	5 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	SS 1	>90
					5 Current	SE	GR	HW 1-3	CL 1-3	CL 1-3	SS 1	98
					5 Rating	Functioning Appropriately						
6	0.9	USFS	3	1	6 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	SS 1	>90
					6 Current	SE	GR	HW 1-3	CL 1-3	CL 1-3	SS 1	98
					6 Rating	Functioning Appropriately						
7	0.3	USFS	3	2	7 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	GR	>90
					7 Current	SE	GR	HW 1-3	CL 1-3	CL 1-3	CW 1-2	99
					7 Rating	Functioning Appropriately						

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

The dominant plant types in all seven of the reaches--sedge, grass, willow, and lodgepole pine--are highly similar to late-seral species in composition and structure, resulting in adequate cover to protect stream banks and dissipate energy during high flows. There is evidence, however, of lodgepole pine encroachment into the riparian area over much of the streams length, but especially in Reach 2. There are also small, localized areas of bank instability, mainly in reaches 2 and 3. Overall, late-seral species dominate and bank stability exceeds 95% in all surveyed reaches; consequently, this element is **functioning appropriately**.

The dominance of late-seral species in all reaches promotes their high bank stability values. Past livestock practices have likely influenced vegetative conditions, especially the lack of mature willow, but current grazing strategies are allowing riparian areas to move towards their potential. Grazing strategies were changed in 1995 with all reaches being in a pasture that is part of a deferred-rotation system (early use one year, then later use the next). The altered fire regime continues to promote higher densities of lodgepole pine in riparian areas, creating a minor shift in relative species abundance. For example, surveys and associated photographs in reaches 2 and 3 indicate that pole to small tree size lodgepole pine are competing with willow in the riparian area. An additional factor affecting bank stability within this stream might be the

increased drainage network associated with roads throughout the subwatershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

Watson Creek

Table 5.4. Watson Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Condition	Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
						Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	1.4	USFS/ Private	6	2	1 Desired	SE	HW 1-4	GR	SS 1	SS 1	GR	>90
					1 Current	SE	HW 1-4	SS 1	GR	SS 1	GR	91
					1 Rating	Functioning Appropriately						
2	1.5	USFS	7	2	2 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	GR	>90
					2 Current	SE	GR	HW 1-3	CL 2-3	CL 2-3	GR	96
					2 Rating	Functioning Appropriately						
3	0.9	USFS	6	2	3 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	GR	>90
					3 Current	SE	GR	HW 1-3	CL 2-3	CL 2-3	GR	91
					3 Rating	Functioning Appropriately						
4	1.1	USFS	5	2	4 Desired	SE	GR	HW 1-4	CL 1-2	CL 2-3	GR	>90
					4 Current	SE	GR	CL 1-2	HW 1-3	CL 2-3	GR	86
					4 Rating	Functioning Appropriately but-at-Risk						
5	0.8	USFS	4	1	5 Desired	SE	GR	HW 1-4	CL 1-3	SS 1 / CL 2-3	GR	>90
					5 Current	SE	GR	CL 1-3	HW 1-2	SS 1 / CL 2-3	GR	91
					5 Rating	Functioning Appropriately						
6	0.5	Private	4	1	6 Desired	SE	GR	HW 1-4	SS 1	SS 1	GR	>90
					6 Current	SE	GR	HW 1	SS 1	SS 1	GR	97
					6 Rating	Functioning Appropriately						

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

The dominant plant types in reaches 1-3 are highly similar to late-seral species in composition and structure, resulting in bank stability values of 91% of greater. For these reasons, all three reaches are **functioning appropriately.** Bank stability in Reach 4 is 86%, and grass and lodgepole pine are more dominant than expected resulting in a **functioning appropriately but-at-risk** rating. Reach 5 is quite similar to Reach 4 in terms of species composition and structure, but bank stability is 91%, which results in a **functioning appropriately** rating. Reach 6 has 97% bank stability with vegetation composition similar to late-seral conditions, thus the reach receives a **functioning appropriately** rating. There is evidence of lodgepole pine encroachment into the riparian area in almost every reach, but most notably in reaches 4 and 5. There are also small, localized areas of bank instability in each reach, but mainly in reaches 1, 3, 4 and 5. Old beaver ponds/dams that were not maintained are a contributing factor to the 9% unstable banks in Reach 1.

The abundance of late-seral vegetation, primarily sedge, promotes the high bank stability values found along the entire length of Watson Creek. As with the other two streams in this subwatershed, past livestock practices have likely influenced vegetative conditions, especially the lack of mature willow. Current grazing strategies are allowing riparian areas to move towards their potential. Grazing strategies were changed in 1995 with all reaches being in a pasture that is part of a deferred-rotation system (early use one year, then later use the next). The altered fire regime continues to promote higher densities of lodgepole pine in riparian areas, creating a minor shift in relative species abundance. For example, surveys and associated photographs in reaches 4 and 5 indicate that pole to small tree size lodgepole pine are competing with willow in the riparian area. An additional factor affecting bank stability within this stream might be the increased drainage network associated with roads throughout the subwatershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

Long Creek Subwatershed: No surveys occurred within this subwatershed, however, past field reconnaissance provides

some insight to the current condition of stream channels and riparian conditions. Bank instability is localized within the subwatershed, occurring primarily in the lower-gradient, depositional reaches. This bank instability is likely the cumulative effect of past grazing practices, extensive logging activities, and the increased drainage network associated with roads throughout the subwatershed – which is possibly influencing the timing and magnitude of stream flows and their effects on channel scouring. Vegetation composition within riparian areas includes grasses, sedges, willow, aspen, and conifers, which is similar to the vegetation composition that is expected within these areas. However, grasses and False Hellebore do dominate some sites, evidence of disturbance or overuse in these areas. Also, aspen is present in varying conditions with some stands struggling to survive. For these reasons, riparian vegetation and associated bank stability within the Long Creek subwatershed is **functioning appropriately but-at-risk**.

Upper Sycan River Subwatershed: The following tables (Tables 5.5 and 5.6) summarize current and desired conditions for vegetation types and associated bank stability within riparian areas of the Sycan River and Skull Creek. Ratings given within these tables are based on a comparison of current and desired conditions (see desired conditions in Chapter 4 for ratings) within each of the surveyed stream reaches. Following each table is a discussion of these ratings and the factors contributing to current conditions, as well as any trends in conditions. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

Sycan River

Table 5.5. Sycan River – Riparian Vegetation and Associated Bank Stability

Reach Information					Condition	Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
						Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	2.3	USFS	38	2	1 Desired	SE	HW 1-4	GR		CP 4	GR	>90
					1 Current	GR	SE	HW 1-2		CP 4	GR	90
					1 Rating	Functioning Appropriately but-at-Risk						
2	1.6	USFS	39	2	2 Desired	SE	HW 1-4	GR	CP 3-4	CP 4	GR	>90
					2 Current	SE	HW 1-2	GR	CP 2-4	CP 4	GR	99
					2 Rating	Functioning Appropriately						
3	1.3	USFS	32	3	3 Desired	SE	HW 1-4	GR	CP 3-4	CP 3-4	GR	>90
					3 Current	SE	HW 1-2	GR	CP 2-4	CP 2-4	GR	98
					3 Rating	Functioning Appropriately						
4	4.3	USFS	36	3	4 Desired	SE	GR	HW 1-4	CP 3-4	CP 3-4	GR	>90
					4 Current	SE	GR	HW 1-2	CP 2-4	CP 2-4	GR	97
					4 Rating	Functioning Appropriately						
5	1.9	USFS	30	3	5 Desired	SE	HW/HA /HD 1-4	GR	CL/CP 2-4	CL/CP 2-4	GR	>90
					5 Current	SE	HW/HA /HD 1-3	GR	CL/CP 1-4	CL/CP 1-4	GR	100
					5 Rating	Functioning Appropriately						
6	0.8	USFS	30	2	6 Desired	SE	HW 1-4	GR	CL 3-4	CL 3-4	GR	>90
					6 Current	SE	HW 1-3	GR	CL 1-4	CL 1-4	GR	99
					6 Rating	Functioning Appropriately						
7	1.9	USFS	24	1	7 Desired	SE	HW 1-4	GR	CL 3-4	CL 3-4	GR	>90
					7 Current	SE	HW 1-3	GR	CL 1-4	CL 1-4	GR	100
					7 Rating	Functioning Appropriately						
8	1.5	USFS	22	3	8 Desired	SE	GR	HW 1-4	CL 3-4	CL 3-4	GR	>90
					8 Current	SE	GR	HW 1-2	CL 1-4	CL 1-4	GR	98
					8 Rating	Functioning Appropriately						
9	2.4	USFS	22	2	9 Desired	SE	HW/HD 1-4	GR	CL 3-4	CL 3-4	GR	>90
					9 Current	SE	HW/HD 1-4	GR	CL 1-4	CL 1-4	GR	100
					9 Rating	Functioning Appropriately						
10	1.6	USFS	20	1	10 Desired	SE	HW 1-4	GR	CL 2-4	CL 3-4	GR	>90
					10 Current	SE	HW 1-4	GR	CL 1-4	CL 1-4	GR	99
					10 Rating	Functioning Appropriately						
11	0.6	USFS	17	2	11 Desired	SE	HW 1-4	GR	CL 3-4	CL 3-4	GR	>90
					11 Current	SE	HW 1-3	GR	CL 1-4	CL 1-4	GR	98
					11 Rating	Functioning Appropriately						
12	3.2	USFS	12	1	12 Desired	SE	HW 1-4	GR	SS 1	SS 1	GR	>90
					12 Current	SE	HW 1-3	GR	SS 1	SS 1	GR	94
					12 Rating	Functioning Appropriately						
13	4.0	USFS	4	2	13 Desired	SE	HW 1-4	GR	CL 3-4	CL 3-4	GR	>90
					13 Current	SE	GR	HW 1-2	CL 1-4	CL 1-4	GR	98
					13 Rating	Functioning Appropriately but-at-Risk						

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

The bank stability in Reach 1 is 90%, with most of the instability occurring in the lower part of the reach. In addition grass and rush are more common than expected indicating that plant succession in moving towards, but has not yet reached, a late-seral community. For these reasons, Reach 1 receives a **functioning appropriately but-at-risk** rating. Reaches 2-5 and 8-9 occur in steeper gradient, forested areas and are **functioning appropriately** due to the dominance of late-seral species and bank stability being greater than 97%. Reaches 6 and 7, and 10-13, are lower gradient meandering stream types with bank stability values greater than 94%. Riparian vegetation within all of these reaches, with the exception of Reach 13, is highly similar to late-seral species composition and structure, and combined with bank stability values results in a **functioning appropriately** rating for each reach. Reach 13, however, is **functioning appropriately but-at-risk** due to a higher

abundance of grass and the lack of willow in the older age-classes. There is evidence of lodgepole pine encroachment into the riparian area in reaches 5-13.

Naturally stable stream types (Refer to Rosgen channel type discussion) and the dominance of late-seral species in reaches 2, 3, 4, 5, 8, and 9 promote the high bank stability values. The abundance of late-seral vegetation, primarily sedge, promotes the high bank stability values found along the remainder of the reaches – the exception being Reach 1 where grass is the dominant species. An additional factor affecting bank stability within this stream, especially in the lower reaches, might be the increased drainage network associated with roads throughout the watershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring. Similar to the other streams within the watershed, past livestock practices have likely influenced vegetative conditions, especially the lack of mature willow in some of the reaches. Current grazing strategies, however, are allowing riparian areas to move towards their potential. Grazing strategies in most of the pastures that include the Sycan River were changed in either 1994, 1995, or 1996. The majority of the reaches are in a pasture that is part of a deferred-rotation system (early use one year, then later use the next), such as reaches 6 to the lower half of Reach 12, or a high intensity/low frequency, deferred rotation strategy (Reach 13). The upper portion of Reach 12 is within the Withers Special Use Pasture. Here, the river has been excluded from grazing (by electric fence) for the past five grazing seasons – only minimal use has been allowed in the upstream half of the pasture for the past two years. In reaches 1-5, the topography of the river canyon functions as the allotment boundary separating two allotments, however, no fences exist along the river. A few head of cattle do find their way down to the river from both sides and can spend a substantial amount of the grazing season within the river corridor. To the north of the river is a deferred grazing management strategy; while to the south is season-long use. Overall, it appears that riparian conditions have improved along the Sycan River since these grazing management change have occurred. The altered fire regime continues to promote higher densities of lodgepole pine in riparian areas in reaches 5-13, creating a minor shift in relative species abundance.

Skull Creek

Table 5.6. Skull Creek – Riparian Vegetation and Associated Bank Stability

Reach Information					Condition	Riparian Area Vegetation and Associated Bank Stability						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Riparian Vegetation (Flood-Prone Width) – Species and Class				Upland Vegetation – Species and Class		Bank Stability (%)
						Dom.	Sub-Dom. 1	Sub-Dom. 2	Sub-Dom. 3	Dom.	Sub-Dom. 1	
1	1.1	USFS	4	1	1 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	SS 1	>90
					1 Current	SE	GR	HW 1-2	CL 1-3	CL 1-3	SS 1	98
					1 Rating	Functioning Appropriately						
2	0.4	USFS	4	<1	2 Desired	SE	GR	HW/HB 1-4	CL 2-3	CL 2-3	CP 2-4	>90
					2 Current	SE	GR	HW/HB 1-2	CL 1-3	CL 1-3	CW 1-2	99
					2 Rating	Functioning Appropriately						
3	1.9	USFS	3	<1	3 Desired	SE	GR	SS 1	CL 2-3	CL 2-3	CP 2-4	>90
					3 Current	SE	GR	SS 1	CL 1-3	CL 1-3	CP 1-3	96
					3 Rating	Functioning Appropriately						
4	1.1	USFS	3	<1	4 Desired	SE	GR	HW 1-4	CL 2-3	CL 2-3	CP 2-4	>90
					4 Current	SE	GR	HW 1-3	CL 1-3	CL 1-3	CP 1-3	97
					4 Rating	Functioning Appropriately						
5	1.1	USFS	3	2-4	5 Desired	SE	GR	HW 1-4	HB 1-3	CL 2-4	CP 2-4	>90
					5 Current	SE	GR	HW 1-3	HB 1-3	CL 1-3	CW 1-3	98
					5 Rating	Functioning Appropriately						
6	0.5	USFS	1-2	2-4	6 Desired	SE	GR	HW/HQ 1-4	CL 2-4	CL 2-4	CW 2-3	>90
					6 Current	SE	GR	HW/HQ 1-3	CL 1-4	CL 1-4	CW 1-3	99
					6 Rating	Functioning Appropriately						

Vegetation Abbreviations: *Conifers:* CP-Ponderosa, CW-White Fir, CL-Lodgepole, CJ-Juniper; Class (diameter breast height): 1-Shrub/Seedling (1"-4.9"), 2-Sapling/Pole (5"-8.9"), 3-Small Trees (9"-20.9"), 4-Large Trees (21"-31.9"), 5-Mature Trees (>32")
Hardwoods: HA-Alder, HW-Willow, HC-Cottonwood, HQ-Quaking Aspen, HD-Dogwood, HB-bog Birch, HX-Other; Class (height): 1 – (0-2ft.), 2 – (2-5ft.), 3 (5-10ft.), 4 (>10ft.)
Shrubs & Grass/Forb: SB-Big Sage, SS-Silver Sage, GR-Grass, SE-Sedge, RU-Rush

The dominant plant types in all six of the reaches--sedge, grass, willow, and lodgepole pine--are highly similar to late-seral species in composition and structure, resulting in adequate cover to protect stream banks and dissipate energy during high flows. There is evidence, however, of historical livestock impacts along this stream and surveyors noted bank trampling during the recent stream survey. Also, the encroachment of lodgepole pine into the riparian area was noted in many of the reaches. There are also small, localized areas of bank instability, mainly in reaches 3 and 4. Overall, late-seral species

dominate and bank stability exceeds 96% in all surveyed reaches; consequently, this element is **functioning appropriately**.

The dominance of late-seral species in all reaches promotes their high bank stability values. Past livestock practices have influenced bank stability and vegetative conditions, especially the lack of mature willow (primarily reaches 1 and 2), but it appears that current grazing strategies are allowing riparian areas to move towards their potential. Grazing strategies were changed in 1995 with all reaches being in a pasture that is part of a deferred-rotation system (early use one year, then later use the next). An observation made during the 1999 grazing season is that Skull Creek seems to be used by livestock as a travel corridor to the Sycan River. This may explain some of the higher impacts (bank trampling, etc.) noted in Skull Creek versus the other streams surveyed within the watershed. Also noted in stream surveys, was the scattered encroachment of lodgepole pine into riparian areas, likely the result of the altered fire regime. An additional factor affecting bank stability within this stream might be the increased drainage network associated with roads throughout the subwatershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

2. Rosgen Stream Type(s)

Paradise Creek Subwatershed: The following tables (Tables 5.7, 5.8, and 5.9) summarize current and desired stream types for Paradise, Crazy, and Watson Creeks. Ratings given within these tables are based on a comparison of current and desired conditions (see desired conditions in Step 4 for ratings) within each of the surveyed stream reaches. Following each table is a discussion of these ratings and the factors contributing to current conditions, as well as any trends in conditions. When two or more stream types are listed for a reach, the dominant is listed first. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

Paradise Creek

Table 5.7. Paradise Creek – Rosgen Stream Types

Reach Information					Condition	Rosgen Stream Type(s) and Associated Bankfull W/D Ratio	
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	0.7	USFS	9	1	1 Desired	C	13-25
					1 Current	C	17
					1 Rating	Functioning Appropriately	
2	2.1	USFS	13	2-4	2 Desired	B, C	13-25
					2 Current	B, C	23
					2 Rating	Functioning Appropriately	
3	2.0	USFS	11	1	3 Desired	C, B	13-25
					3 Current	C, B	20
					3 Rating	Functioning Appropriately	
4	0.6	USFS	12	1	4 Desired	C, B	13-25
					4 Current	C, B	19
					4 Rating	Functioning Appropriately	
5	0.8	USFS	4	1	5 Desired	E	<12
					5 Current	C, E	14
					5 Rating	Functioning Appropriately but-at-Risk	
6	0.4	Private	3	<1	6 Desired	E	<12
					6 Current	C, E	19
					6 Rating	Functioning Appropriately but-at-Risk	
7	0.7	USFS	3	<2	7 Desired	E	<12
					7 Current	E	11
					7 Rating	Functioning Appropriately	
8	1.2	USFS	4	4	8 Desired	E, B	<12
					8 Current	E, B	10
					8 Rating	Functioning Appropriately	
9	0.5	USFS	4	8	9 Desired	A, E	<12
					9 Current	A, E	10
					9 Rating	Functioning Appropriately	

Reaches 1, 2, 3, 4, 7, 8 and 9 are all **functioning appropriately** in terms of their potential stream type. For these reaches, the shape and size of the stream is in balance with its geomorphic setting. Reaches 1, 3, 4, and 7 are C and E stream types, those

characterized by low-gradients, active floodplains, and low width-to-depth ratios. Portions of each of these reaches have experienced some level of downcutting in the past, but most areas have substantially recovered, or continue to recover, moving towards their desired state. Reaches 2, 8 and 9 occur on steeper slopes, with gentle sideslopes and larger stream substrates that aid in channel stability.

In contrast, reaches 5 and 6 (also portions of reach 7) have stream channels that are similar to the stream type expected for their settings, but their bankfull width-to-depth ratios are greater than expected and thus are determined to be **functioning appropriately but-at-risk**. These reaches have smaller drainage areas (less than 18 square miles), and thus we would expect E stream types – Reach 5 may be the exception, since it is downstream of the junction with Watson Creek.

The late-seral vegetation described in the previous section contributes to the stability of C and E stream types. The dominance of sedge along reaches 1, 3, 4, and 7 promote bank stability, with channels that are resistant to the erosive energy associated with high flows. Along the steeper-gradient reaches (2, 8 and 9) the local geology and larger substrate sizes contribute to the channel stability. An abundance of late-seral riparian vegetation is essential for maintaining low-gradient stream types, like those found in reaches 5 and 6. However, these reaches are lacking willow and have an abundance of grasses and rushes, which are contributing to the unstable stream banks within these reaches and the functioning appropriately but-at-risk ratings. These reaches, as well as portions of reaches 1, 3, 4 and 7, are still recovering, moving along the evolutionary path for degraded low-gradient systems. As late-seral vegetation continues to develop along these reaches, it will act to trap sediment and build banks, causing the channel to narrow and deepen, moving towards its naturally stable and desired state. Finally, the cumulative effects of past land management activities – upland vegetation and road density both received functioning appropriately but-at-risk ratings – within the subwatershed, along with continued grazing, may be influencing the ability of the stream channels to revegetate and form stable banks.

Crazy Creek

Table 5.8. Crazy Creek – Rosgen Stream Types

Reach Information					Condition	Rosgen Stream Type(s) and Associated Bankfull W/D Ratio	
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	1.7	USFS	5	3	1 Desired	E_b, B, C_b	<12
					1 Current	E_b, B, C_b	10
					1 Rating	Functioning Appropriately	
2	1.4	USFS	5	1	2 Desired	E	<12
					2 Current	E	5
					2 Rating	Functioning Appropriately	
3	0.8	USFS	5	1	3 Desired	E	<12
					3 Current	E	6
					3 Rating	Functioning Appropriately	
4	0.6	USFS	4	1	4 Desired	E	<12
					4 Current	E	4
					4 Rating	Functioning Appropriately	
5	0.9	USFS	4	1	5 Desired	E	<12
					5 Current	E	4
					5 Rating	Functioning Appropriately	
6	0.9	USFS	3	1	6 Desired	E	<12
					6 Current	E	4
					6 Rating	Functioning Appropriately	
7	0.3	USFS	3	2	7 Desired	E	<12
					7 Current	E	6
					7 Rating	Functioning Appropriately	

E_b or C_b refers to E and C stream types with steeper gradients (2-4%)

All reaches of Crazy Creek are **functioning appropriately** in terms of their potential stream type as the shape and size of the stream channel is in balance with its setting. Reach 1 is a mix of stream types that typically have moderate gradients, gentle sideslopes, gravel/cobble substrates, and some level of floodplain development – although some portions of the reach are more confined due to the adjacent sideslopes. Reaches 2-7 are typical "E" stream types characterized by low gradients, developed floodplains, and low width-to-depth ratios.

The dominance of sedge in these reaches promotes high bank stability and narrow deep channels that are resistant to the

erosive energy associated with high flows. Also, management activities appear to be conducive to maintaining vegetation in the well-developed floodplains, which are able to dissipate energy associated with high flow events. Any modification to the magnitude and timing of stream flows has not shifted channels from their natural potential, even though upland vegetation and road density both received functioning appropriately but-at-risk ratings.

Watson Creek

Table 5.9. Watson Creek – Rosgen Stream Types

Reach Information					Condition	Rosgen Stream Type(s) and Associated Bankfull W/D Ratio	
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	1.4	USFS/ Private	6	2	1 Desired	E	<12
					1 Current	E, C	12
					1 Rating	Functioning Appropriately but-at-Risk	
2	1.5	USFS	7	2	2 Desired	E, B	<12
					2 Current	E, C, B	12
					2 Rating	Functioning Appropriately but-at-Risk	
3	0.9	USFS	6	2	3 Desired	E, B	<12
					3 Current	E, C, B	11
					3 Rating	Functioning Appropriately	
4	1.1	USFS	5	2	4 Desired	E, B	<12
					4 Current	E, C, B	12
					4 Rating	Functioning Appropriately but-at-Risk	
5	0.8	USFS	4	1	5 Desired	E, B	<12
					5 Current	E, C, B	10
					5 Rating	Functioning Appropriately	
6	0.5	Private	4	1	6 Desired	E	<12
					6 Current	E	10
					6 Rating	Functioning Appropriately	

Reaches 1, 2, and 4 have stream channels which are similar to the stream type expected for their setting, however, their bankfull width-to-depth ratios are slightly greater than expected and thus are determined to be **functioning appropriately but-at-risk**. It should be noted that reaches 2 and 4 have a mix of stream types, and portions of all reaches have experienced some level of downcutting in the past, both of which influence bankfull width-to-depth ratios. In contrast, reaches 3, 5, and 6 are **functioning appropriately** in terms of their potential stream type. For these reaches the shape and size of the stream is in balance with its geomorphic setting. Portions of all three reaches have also experienced some level of downcutting in the past, and reaches 3 and 5 exhibit a mix of stream types.

An abundance of late-seral riparian vegetation is essential for maintaining low-gradient stream types, like those found along Watson Creek. Portions of reaches 1, 2, and 4 are still recovering, moving along the evolutionary path for degraded low-gradient systems. These areas have less willow and more grass than expected, which are contributing to the unstable stream banks within these reaches and the functioning appropriately but-at-risk ratings. As late-seral vegetation continues to develop along these reaches, it will act to trap sediment and build banks, causing the channel to narrow and deepen, moving towards its naturally stable and desired state. The dominance of sedge along reaches 3, 5, and 7 promote bank stability, with channels that are resistant to the erosive energy associated with high flows. As mentioned above, these reaches have also experienced downcutting, but channels are a little narrower and deeper than those in the other three reaches. Also, by maintaining vegetation in the well-developed floodplains, which are able to dissipate energy associated with high flow events, trap sediments, and build banks, management activities appear to be conducive to allowing the stream to move towards its desired state. An additional factor that may be influencing stream channel morphology within this stream might be the increased drainage network associated with roads throughout the subwatershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

Long Creek Subwatershed: No surveys occurred within this subwatershed, however, past field reconnaissance provides some insight to the current condition of stream channels. Within this subwatershed, stream channels are typically characterized as Rosgen B stream types, where local geology and large substrate sizes contribute to the channel stability. Small inclusions of Rosgen C stream types occur in the lower gradient, depositional reaches, which are the main areas within

the subwatershed where bank instability occurs. This bank instability, and associated downcutting, are likely the cumulative effect of past grazing practices, extensive logging activities, and the increased drainage network associated with roads throughout the subwatershed – which is possibly influencing the timing and magnitude of stream flows and their effects on channel scouring. For these reasons, and taking into account the rating given for riparian vegetation and associated bank instability, an overall rating of **functioning appropriately but-at-risk** is given for stream channels within this subwatershed.

Upper Sycan River Subwatershed: The following tables (Tables 5.10 and 5.11) summarize current and desired stream types for the Sycan River and Skull Creek. Ratings given within these tables are based on a comparison of current and desired conditions (see desired conditions in Chapter 4 for ratings) within each of the surveyed stream reaches. Following each table is a discussion of these ratings and the factors contributing to current conditions, as well as any trends in conditions. When two or more stream types are listed for a reach, the dominant is listed first. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

Sycan River

Table 5.10. Sycan River – Rosgen Stream Types

Reach Information					Condition	Rosgen Stream Type(s) and Associated Bankfull W/D Ratio	
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	2.3	USFS	38	2	1 Desired	C	13-25
					1 Current	C	57
					1 Rating	Functioning Appropriately but-at-Risk	
2	1.6	USFS	39	2	2 Desired	B	13-38
					2 Current	B	30
					2 Rating	Functioning Appropriately	
3	1.3	USFS	32	3	3 Desired	B	13-38
					3 Current	B	28
					3 Rating	Functioning Appropriately	
4	4.3	USFS	36	3	4 Desired	B	13-38
					4 Current	B	37
					4 Rating	Functioning Appropriately	
5	1.9	USFS	30	3	5 Desired	B	13-38
					5 Current	B	24
					5 Rating	Functioning Appropriately	
6	0.8	USFS	30	2	6 Desired	C	13-25
					6 Current	C	34
					6 Rating	Functioning Appropriately but-at-Risk	
7	1.9	USFS	24	1	7 Desired	C, B	13-25
					7 Current	C, B	21
					7 Rating	Functioning Appropriately	
8	1.5	USFS	22	3	8 Desired	B, C	13-38
					8 Current	B, C	19
					8 Rating	Functioning Appropriately	
9	2.4	USFS	22	2	9 Desired	B	13-38
					9 Current	B	16
					9 Rating	Functioning Appropriately	
10	1.6	USFS	20	1	10 Desired	C, B	13-25
					10 Current	C, B	18
					10 Rating	Functioning Appropriately	
11	0.6	USFS	17	2	11 Desired	C	13-25
					11 Current	C	22
					11 Rating	Functioning Appropriately	
12	3.2	USFS	12	1	12 Desired	E, C	<12
					12 Current	C, E	12
					12 Rating	Functioning Appropriately	
13	4.0	USFS	4	2	13 Desired	E	<12
					13 Current	E, C	12
					13 Rating	Functioning Appropriately but-at-Risk	

Reaches 1, 6 and 13 have stream channels that are similar to the stream type expected for low-gradient, meandering systems (C for reaches 1 and 6 – large drainage areas; E for reach 13 – small drainage area). These three reaches are **functioning appropriately but-at-risk**, however, because their bankfull width-to-depth ratios are higher than expected. Reaches 2-5, 8 and 9 are **functioning appropriately** in terms of their potential stream type and have channels that are in balance with their geomorphic setting. These reaches are B stream types, with low-to-moderate gradients, gentle sideslopes, and cobble/boulder-gravel substrates that aid in channel stability. The shape and size of stream channels in reaches 7, 10, 11 and 12 are similar to the stream type (C for reaches 7, 10, and 11; E/C for Reach 12) expected for their settings, and thus are determined to be **functioning appropriately**. Portions of each of the C and E stream reaches have experienced some level of downcutting in the past, but most areas (with the exception of Reach 1) have substantially recovered, or continue to recover, moving towards their desired state.

In Reach 1, the lack of late-seral species, and the abundance of grasses and rushes, contributes to the functioning appropriately but-at-risk rating. An additional factor that may be influencing stream channel morphology within this reach is the cumulative effects of past land management activities – both upland vegetation and road density received functioning appropriately but-at-risk ratings, within this and other subwatersheds. The increased drainage network associated with roads

throughout the watershed has likely modified the timing and magnitude of stream flows in the Sycan River. This, along with continued livestock grazing, may be influencing the ability of the stream channel to revegetate and form stable banks. Along the B stream types in reaches 2-5, 8 and 9, the local geomorphology and larger substrate sizes contribute to the stability of the stream. In the non-meadow, or transitional lower-gradient reaches – those reaches with C and B stream types (reaches 7 and 10) – the local geomorphology and larger substrate sizes contribute to stream stability, as well as an abundance of late-seral species such as sedge and willow. In the remaining low gradient, meandering stream reaches (reaches 6, 11, 12 and 13) the abundance of late-seral vegetation maintains channel integrity. The dominance of sedge and willow in reaches 6, 11, and 12 promote high bank stability, with channels and floodplains that are resistant to the erosive energy of high flows. Although, there is an abundance of late-seral vegetation within Reach 6, the channel has been unable to readjust to a lower width-to-depth ratio. Possible explanations for its higher than expected width-to-depth ratio may simply be associated with the larger stream bed substrates, and/or the fact that the reach is located directly downstream of the confluence with Paradise Creek. The river, at this point, may have had to adjust to any changes in the timing and magnitude of flows associated with cumulative effects from roads and past harvesting activities both within the Paradise Creek subwatershed, as well as the drainage area above this confluence. In Reach 13, the stream is a little wider than desired which could be a function of the higher abundance of grasses and lack a willow. Segments of reaches 12 and 13 have experienced downcutting in the past, but most areas have substantially recovered, or continue to recover, moving towards their desired state.

Skull Creek

Table 5.11. Skull Creek – Rosgen Stream Types

Reach Information					Condition	Rosgen Stream Type(s) and Associated Bankfull W/D Ratio	
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	Rosgen Stream Type(s)	Bankfull Width/Depth Ratio
1	1.4	USFS	4	1	1 Desired	E, E_b	<12
					1 Current	E, E_b	5
					1 Rating	Functioning Appropriately	
2	0.4	USFS	4	<1	2 Desired	E, B	<12
					2 Current	E, B	9
					2 Rating	Functioning Appropriately	
3	1.9	USFS	3	<1	3 Desired	E	<12
					3 Current	E	3
					3 Rating	Functioning Appropriately	
4	1.1	USFS	3	<1	4 Desired	E	<12
					4 Current	E	4
					4 Rating	Functioning Appropriately	
5	1.1	USFS	3	2-4	5 Desired	E_b, B	<12
					5 Current	E_b, B	4
					5 Rating	Functioning Appropriately	
6	0.5	USFS	1-2	2-4	6 Desired	E_b, B	<12
					6 Current	E_b, B	7
					6 Rating	Functioning Appropriately	

E_b or C_b refers to E and C stream types with steeper gradients (2-4%)

All reaches of Skull Creek are **functioning appropriately** in terms of their potential stream type as the shape and size of the stream channel is in balance with its setting. Reaches 1-4 are characterized by low gradients, developed floodplains, and low width-to-depth ratios. Reaches 5 and 6 have a mix of stream types that typically have moderate gradients, gentle sideslopes, gravel/cobble substrates, and some level of floodplain development – although some portions of these reaches are more confined due to the adjacent sideslopes. Portions of each of these reaches have experienced some level of downcutting in the past, but most areas have substantially recovered, or continue to recover, moving towards their desired state.

The dominance of sedge in these reaches promotes high bank stability and narrow deep channels that are resistant to the erosive energy associated with high flows. Also, management activities appear to be conducive to maintaining vegetation in the floodplains, which are able to dissipate energy associated with high flow events. There is evidence, however, of past downcutting along much of the stream and surveyors noted bank trampling during the recent stream survey. Although these livestock impacts were noted, the current grazing strategy appears to be allowing riparian areas and stream channels to move towards their potential. An additional factor that may be influencing stream channel morphology within this stream might be the increased drainage network associated with roads throughout the subwatershed, possibly influencing the timing and magnitude of stream flows and their effects on channel scouring.

Watershed Summary - Riparian Vegetation and Stream Channels

Approximately 55 miles of stream were surveyed within two of the three subwatersheds and were distributed in the following manner: Paradise Creek (9 miles); Crazy Creek (7 miles); Watson Creek (6 miles); Sycan River (27 miles); Skull Creek (6 miles). The following is a short summary of riparian and stream channel conditions within the entire Upper Sycan Watershed. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

Past anthropogenic activities such as grazing, logging and road construction, and trapping have affected the hydrologic regime and influenced erosion and sediment delivery to streams, and have altered the natural cycles of disturbance. These factors have combined to cause changes in channel conditions throughout the analysis area and have resulted in channel/riparian conditions different than what existed prior to settlement. Where concentrated grazing, roads and skid trails are located within drainages and/or riparian areas, riparian ecosystems have been affected. Historic beaver activities are located throughout the streams within the analysis area, but in most cases the dams are no longer active and no longer impound water or provide pool habitat and sediment retention to the stream systems. Additionally, encroachment of conifers into the floodplain is evidence that the riparian zones may be narrowing and that streamside riparian areas have a lower water table than potential for the streams.

1. Riparian Vegetation and Associated Bank Stability

Eighty percent of the 41 reaches surveyed (78% of the miles surveyed) have an abundance of late-seral riparian vegetation, thus are **functioning appropriately**, while 15% of the reaches (20% of the miles surveyed) are **functioning appropriately but-at-risk**. The remaining 5% (2% of the miles surveyed) are **functioning inappropriately**. The majority of those reaches functioning appropriately are B and E stream types, most having an abundance of late seral vegetation and high bank stability, exceeding 90%. Those areas that were not rated as functioning appropriately are predominantly C stream types located along the low gradient meadow reaches of Paradise Creek, Watson Creek, and the Sycan River. In general, these meadow reaches have bank stability less than 90% and/or have a lack of sedge, rush, and willow. Because gravel point bars are common in C stream types, greater densities of willow are expected relative to other stream types.

The B stream types are usually located in forested reaches and within canyons, areas that are inherently stable. For this reason, forest management activities (such as timber harvest and grazing) have been conducted away from these stream reaches, leaving them relatively unaffected. However, the lack of fire continues to promote higher densities of conifers in riparian areas along B stream types, creating a minor shift in relative species abundance. In addition, the E stream types found throughout the watershed are characterized and maintained by late-seral vegetation, resulting from grazing management which appears conducive to late-seral plant composition. As mentioned above, the majority of stream reaches that are not functioning appropriately are the C stream types located along the low gradient meadow reaches of Paradise Creek, Watson Creek, and the Sycan River. Because these are areas of high forage production, late season grazing practices have altered riparian vegetation. For example, these areas have the potential to produce greater densities of large willow than currently exists; however, cattle graze willow during the late summer because the desirable grasses have lost their palatability and protein contents.

2. Rosgen Stream Type(s)

Numerous sites along the surveyed stream reaches were measured to determine Rosgen stream types. Of the 41 reaches, 33 (80%) – 78% of the miles surveyed – were **functioning appropriately** in terms of their potential stream type--as the shape and size of the stream channel is in balance with its setting. The 8 remaining reaches (20%) of are **functioning appropriately but-at-risk**. The three dominant stream types within the watershed are B, C, and E, with only small portions of comprised of A, F, and G stream types. Most stream reaches that are functioning appropriately (80%) are the B and E stream types found throughout the watershed, while those which are functioning appropriately but-at-risk (20%) are C and E stream types that have width-to-depth ratios greater than is expected. Most of the C stream types that are functioning appropriately but-at-risk are primarily located in Paradise Creek, Watson Creek, and the Sycan River.

The B stream types are inherently stable because of geology and other landscape characteristics, such as large woody debris from forested areas and large streambed substrates. As expected, all of these stream types were in balance with their landscape setting. The majority of stream reaches that are not functioning appropriately are the C and E stream types located along the low gradient meadow reaches of Paradise Creek, Watson Creek, and the Sycan River. Because these are areas of high forage production, the meadows have been strongly influenced by grazing practices that have reduced densities of

riparian vegetation important for bank stability and low width-to-depth ratios. In addition, early land management activities have influenced the current water table elevations and floodplain widths for the C and E stream types throughout the watershed. Beaver trapping and historical livestock grazing have led to downcut stream channels in low gradient meadows, converting C and E stream types with wide floodplains into F stream types with little to no floodplain. This resulted in lowered water tables with less water storage and lower base flows. As a result of improved livestock grazing strategies promoted within the watershed, E stream types have, or continue to, reclaim many meadow sites, resulting in the reestablishment of floodplains dominated with late-seral riparian plants. However, the floodplains and areas of water storage are less extensive than they were prior to downcutting. This has likely reduced base flows within the watershed. Furthermore, beaver dams are not present in their historical numbers, further reducing the lateral extent of bank saturation and groundwater storage essential for maintenance of base flows during summer months.

Habitat for Aquatic Species

Key Question 3: Are the channels providing adequate fish habitat?

Paradise Creek Subwatershed: The following tables (Tables 5.12, 5.13, and 5.14) summarize current and desired fish habitat conditions within Paradise, Crazy, and Watson Creeks. Ratings given within these tables are based on a comparison of current and desired conditions (see desired conditions in Chapter 4 for ratings) within each of the surveyed stream reaches. Habitat conditions are summarized based on the following parameters: large woody debris, pools, spawning gravel fines, stream temperature, and fish passage. Information in the LWD, Pools and Large Pools columns represent the 50th and 75th percentile for natural and near natural streams in the northern Great Basin (ICBEMP, 1997). Following each table is a discussion of these ratings and the factors contributing to current conditions, as well as any trends in conditions. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

Paradise Creek

Table 5.12. Paradise Creek – Fish Habitat Elements

Reach Information					Condition	Habitat Elements						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Fish Passage (Culvert)
						50% / 75%	50% / 75%	50% / 75%		(°C)	(°F)	
1	0.7	USFS	9	1	1 Desired	4 / 15	16 / 31	0 / 3	< 20	17.8	64.0	Passage
					1 Current	6	46	9	19	19.7	67.5	Passage
					1 Rating	FA +	FA	FA	FA	FAR		FA
2	2.1	USFS	13	2-4	2 Desired	2 / 10	11 / 22	0 / 2	<20	17.8	64.0	Passage
					2 Current	5	96	6	15	NA	NA	Barrier
					2 Rating	FAR	FA	FA	FA	FAR		FI
3	2.0	USFS	11	1	3 Desired	3 / 12	13 / 25	0 / 2	<20	17.8	64.0	Passage
					3 Current	3	80	3	NA	NA	NA	Passage
					3 Rating	FA +	FA	FA		FAR		FA
4	0.6	USFS	12	1	4 Desired	3 / 11	12 / 23	0 / 2	<20	17.8	64.0	Passage
					4 Current	8	71	2	NA	NA	NA	Passage
					4 Rating	FA +	FA	FAR		FAR		FA
5	0.8	USFS	4	1	5 Desired	**	36 / 70	0 / 7	<20	17.8	64.0	Passage
					5 Current	0	61	5	NA	NA	NA	Passage
					5 Rating		FAR	FAR		FAR		FA
6	0.4	Private	3	<1	6 Desired	**	48 / 93	0 / 9	<20	17.8	64.0	Passage
					6 Current	0	108	3	NA	NA	NA	Passage
					6 Rating		FA	FAR		FAR		FA
7	0.7	USFS	3	<2	7 Desired	**	48 / 93	0 / 9	<20	17.8	64.0	Passage
					7 Current	0	106	0	NA	NA	NA	Passage
					7 Rating		FA	FAR		FA		FA
8	1.2	USFS	4	4	8 Desired	26 / 112	38 / 58	1 / 5	<25	17.8	64.0	Passage
					8 Current	21	128	1	NA	NA	NA	Passage
					8 Rating	FA +	FA	FAR		FA		FA
9	0.5	USFS	4	8	9 Desired	26 / 88	40 / 67	0 / 7	<25	17.8	64.0	Passage
					9 Current	22	131	0	25	14.3	57.7	Barrier
					9 Rating	FA +	FA	FAR	FAR	FA		FAR

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FI – Functioning Inappropriately
NA – Information Not Available; ** - Habitat element not applicable for this reach; + - Rating modified based on reach characteristics
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

1. Large Woody Debris (LWD)

Reaches 1, 2, 3, 4, 8 and 9 are all appropriate sites for LWD; however, all but Reach 2 occur within areas of limited LWD recruitment potential. For this reason, all were determined to be **functioning appropriately** for this element. Conversely, LWD recruitment potential was determined to be adequate along the forested portions of Reach 2, yet LWD was below desired numbers, receiving a **functioning appropriately but-at-risk** rating. Reaches 5, 6, and 7 are primarily meadow sites, areas where LWD in not expected.

Reaches 1, 3, 4, 8 and 9 do not occur within a continuous forested reach but rather a meadow/forest type of environment where the stream flows through both meadow and forested areas. This helps to explain the intermittent nature and low numbers of in-stream wood, and, because calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested, professional judgment – based primarily on LWD recruitment potential – was used to determine if these reaches had appropriate levels of LWD.

2. Pools

All of the reaches surveyed were found to be **functioning appropriately**, except Reach 5, which received a **functioning appropriately but-at-risk** rating. Many of these reaches received functioning appropriately ratings even though the riparian vegetation and/or channel morphology are functioning appropriately but-at-risk or functioning inappropriately. Reaches 1, 2, and 3 also have numbers of large pools exceeding the 75th percentile, resulting in **functioning appropriately** ratings. On the other hand, reaches 4-9 were lacking large pools and received **functioning appropriately but-at-risk** ratings.

Reaches 1-3 appear to be providing adequate pool habitat, with pool complexity occurring through depth, structure and some undercut banks. Pool numbers were also found to be adequate in all of the remaining reaches, except Reach 5, but complexity of these pools is lacking – with reference to depth, structure, undercut banks, etc. This is especially true in reaches 4-7, where streams are wider than desired and lack of late-seral vegetation. As previously mentioned, C and E stream types require an abundance of late-seral vegetation to promote and maintain channel integrity with low width-to-depth ratios – conditions that promote deep and complex pools. Pool frequencies in the remaining reaches are above desired numbers because riparian vegetation and stream channels are highly similar to desired conditions. It should be noted that in the upper reaches, deep pools might be uncommon in the absence of beaver dams.

3. Spawning Gravel Fines

Fine sediment in spawning substrates was sampled at three locations within Paradise Creek. The site in Reach 1, a C stream type, has 19% fine sediments, promoting 76% embryo survival. In Reach 2, a B/C stream type, the percent fines were slightly lower at 15, promoting 83% embryo survival. As a result, both reaches are **functioning appropriately**. At the uppermost sampling station, located in Reach 9 (A/E stream type), the percent fines were found to be 25%, promoting 62% embryo survival and resulting in a **functioning appropriately but-at-risk** rating.

The relatively low sediment levels found at the sampling stations in reaches 1 and 2 are most likely attributed to the high bank stability, the abundance of late-seral vegetation, and appropriate stream types. Although roads and upstream bank instability are contributing to sediment levels, these stream reaches are able to efficiently capture and transport the sediment produced by the subwatershed. The higher values reported in Reach 9, although values are very close to functioning appropriately levels, are unexpected since road crossings and bank instability are minimal upstream from the sampling location. Reported values are likely associated with the naturally high erosion rates associated with soils and geomorphology of the area, as well as localized bank instability.

4. Stream Temperature

Based on stream temperature recordings in reaches 1 and 9 (as well as the influence of Watson Creek), it is assumed that reaches 1-6 are **functioning appropriately but-at-risk**, because the 7-day average maximum temperatures were within, or assumed to be within the 17.8-24.0°C range. In contrast, reaches 7, 8 and 9 are believed to be **functioning appropriately**, based on the 7-day average maximum temperature of 14.3°C in Reach 9. Based on this information, only the upper reaches

of Paradise Creek are considered to have stream temperatures (rearing) that may be favorable for bull trout.

The relatively low stream temperatures found in Reach 9 are a result, in part, of upstream riparian vegetation and stream channels being near their desired state. In contrast the relatively open forest/meadow and meadow reaches found throughout the rest of the system allow temperatures to increase to 19.7°C. In addition, the warmer waters (22.9°C) of Watson Creek enter Paradise Creek at the lower end of Reach 6, which greatly contributes to downstream water temperatures.

As discussed in previous subwatershed evaluations, several of the low-gradient reaches in Paradise Creek have been affected by at least one factor influencing stream temperatures--wide stream channels, loss of riparian and upland shade, lower stream flows caused by increased evapotranspiration, etc. With continued improvement in riparian and stream channel conditions, shading and a narrowing of stream channels should result in lower stream temperatures. However, even though it is assumed that stream temperatures were historically lower than they are today, it is questionable as to whether or not current state standards can be achieved in this stream.

5. Fish Passage (Culvert)

Both of the culverts surveyed along Paradise Creek are considered to be barriers to fish passage. These culverts are located in reaches 2 and 9. Refer to Figure 5.2 - Upper Sycan Watershed Road Locations. The culvert in Reach 2 provides adequate velocities for adult fish passage, has a 4.5 foot deep pool at it's outlet, but has 1 foot vertical drop to the pool at the outlet. The culvert in Reach 9 also has a vertical jump (water surface to culvert outlet) of 1 foot or greater, as well as has velocities that exceed the sustained swimming speeds for trout. Because the culvert on Reach 2 is considered a potential barrier, and is located in the lower portion of the subwatershed, where upstream reaches are inaccessible, this assessment element receives a **functioning inappropriately** rating.

The slope (0.5%) of the culvert in Reach 2 provides acceptable velocity passage for adults, but the reason this culvert is considered a barrier is the vertical jump (water surface to culvert outlet is 1 foot) the fish must encounter. The culvert in Reach 9 is considered a barrier due to its slope (approximately 6%) – which produces velocities that exceed sustained swimming speeds – and a vertical jump of 1.1 feet.

Crazy Creek

Table 5.13. Crazy Creek – Fish Habitat Elements

Reach Information					Condition	Habitat Elements						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Fish Passage (Culvert)
						50% / 75%	50% / 75%	50% / 75%		(°C)	(°F)	
1	1.7	USFS	5	3	1 Desired	6 / 26	28 / 56	0 / 5	<20	17.8	64.0	Passage
					1 Current	41	139	0	13	17.1	63.0	Barrier
					1 Rating	FA	FA	FAR	FA	FA		FI
2	1.4	USFS	5	1	2 Desired	6 / 26	28 / 56	0 / 5	<20	17.8	64.0	Passage
					2 Current	20	153	1	NA	NA	NA	Passage
					2 Rating	FA +	FA	FAR		FA		FA
3	0.8	USFS	5	1	3 Desired	6 / 26	28 / 56	0 / 5	<20	17.8	64.0	Passage
					3 Current	17	228	1	NA	NA	NA	Passage
					3 Rating	FA +	FA	FAR		FA		FA
4	0.6	USFS	4	1	4 Desired	**	35 / 70	0 / 7	<20	17.8	64.0	Passage
					4 Current	0	131	0	NA	NA	NA	Passage
					4 Rating		FA	FAR		FA		FA
5	0.9	USFS	4	1	5 Desired	8 / 33	35 / 70	0 / 7	<20	17.8	64.0	Passage
					5 Current	23	152	8	67	NA	NA	Barrier
					5 Rating	FA +	FA	FAR	FI	FA		FAR
6	0.9	USFS	3	1	6 Desired	**	48 / 93	0 / 9	<20	17.8	64.0	Passage
					6 Current	1	156	0	NA	15.8	60.0	Passage
					6 Rating		FA	FAR		FA		FA
7	0.3	USFS	3	2	7 Desired	11 / 44	48 / 93	0 / 9	<20	17.8	64.0	Passage
					7 Current	9	226	0	NA	NA	NA	Passage
					7 Rating	FA +	FA	FAR		FA		FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FI – Functioning Inappropriately
NA – Information Not Available; ** - Habitat element not applicable for this reach; + - Rating modified based on reach characteristics
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

1. Large Woody Debris (LWD)

Similar to many of the reaches in Paradise Creek, reaches 1, 2, 3, 5 and 7 of Crazy Creek are all appropriate sites for LWD, but the reaches occur in areas of limited LWD recruitment potential. For this reason, all five of these reaches were determined to be **functioning appropriately** for this element. Reaches 4 and 6 were not rated for LWD because they are primarily low gradient meadow sites where LWD is not expected.

Reaches 1, 2, 3, 5 and 7 do not occur within a continuous forested reach but rather a meadow/forest type of environment where the stream flows through both meadow and forested areas. This helps to explain the intermittent nature and low numbers of in-stream wood, and, because calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested, professional judgment – based primarily on LWD recruitment potential – was used to determine if these reaches had appropriate levels of LWD.

2. Pools

All of the reaches surveyed were found to be **functioning appropriately**, with pool numbers exceeding the 75th percentile. Of these reaches, only Reach 5 is **functioning appropriately** in terms of the large pool component, while few deep (large) pools could be found in any of the other reaches, all of which received **functioning appropriately but-at-risk** ratings for the large pool habitat element.

Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are highly similar to desired conditions. Reach 5 appears to be providing adequate large pool habitat, although one of the deep pools occurs at the outlet of a culvert, with pool complexity occurring through depth, structure and undercut banks along narrow meander bends. This same type of complexity does not seem to exist among the pools in the remaining reaches, even though stream channels and riparian vegetation are highly similar to desired conditions. Within many of these reaches, the number of deep pools may remain low with the absence of beaver (dams) within the system.

3. Spawning Gravel Fines

Thirteen percent fine sediments were documented in spawning substrates of Reach 1, promoting 87% embryo survival and resulting in a **functioning appropriately** rating. In Reach 5, the percent fines were found to be 67%, resulting in a **functioning inappropriately** rating and an embryo survival rate of 3%.

The low sediment levels found at the sampling stations in reaches 1 and 2 are most likely attributed to the high bank stability, the abundance of late-seral vegetation, and appropriate stream types. Although roads and upstream bank instability are contributing to sediment levels, these stream reaches are able to efficiently capture and transport the sediment produced by the subwatershed. The higher values that were reported in Reach 5 were unexpected since road crossings and bank instability are both minimal upstream from the sampling location. One possible explanation is that the sample was taken at the lower end of a low gradient meadow reach, which may act as a natural settling point for fine sediment. In addition, reported values are likely associated with the naturally high erosion rates associated with soils and geomorphology of the area, and noted just above the sampling site was one of the few areas of localized bank instability.

4. Stream Temperature

Based on stream temperature recordings in reaches 1 and 6 (7-day average maximum temperatures of 17.1°C and 15.8°C, respectively) it is assumed that all reaches are below 17.8°C, and thus are **functioning appropriately**. However, only the upper reaches of Crazy Creek are considered to have stream temperatures (rearing) that may be favorable for bull trout.

The relatively low stream temperatures found throughout Crazy Creek are a function of upstream riparian vegetation and stream channels being near their desired state. This has led to shading levels (shade information was collected within all reaches of Crazy Creek using a solar pathfinder) also being at or near their desired conditions. Shading values for each reach were compared to data collected for reaches determined to be near their desired or potential condition within the Sprague River system (data from information collected for the Sprague River TMDL – unpublished). Comparisons were made

utilizing information from streams of the same width and riparian community group. Shading levels within Crazy Creek were found to be within the range of values for similar sites that are at or near their potential condition within the Sprague River System. Shading values for Crazy Creek were as follows: (R1) 60%, (R2) 69%, (R3) 55%, (R4) 26%, (R5) 42%, (R6) 26%, and (R7) 69%.

5. Fish Passage (Culvert)

The two culverts surveyed along Crazy Creek, which are located in reaches 1 and 5, are both considered to be barriers to fish passage. Refer to Figure 5.2 - Upper Sycan Watershed Road Locations. Both of these culverts have acceptable jump heights and pools at the outlet of the culvert, but velocities were determined to exceed the sustainable swimming speeds of trout. Because one of these culverts occurs in the lower portion of the stream, this assessment element receives a **functioning inappropriately** rating.

Both of the culverts within this stream have fairly steep slopes (2.2% and 1.3%), which, based on the size and length of the culvert, contribute to flow velocities in the pipe that are higher than sustainable for fish. This is the reason these culverts are considered barriers to fish passage.

Watson Creek

Table 5.14. Watson Creek – Fish Habitat Elements

Reach Information					Condition	Habitat Elements						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Fish Passage (Culvert)
						50% / 75%	50% / 75%	50% / 75%		(°C)	(°F)	
1	1.4	USFS/ Private	6	2	1 Desired	**	24 / 47	0 / 4	<20	17.8	64.0	Passage
					1 Current	2	76	28	NA	22.9	73.2	Passage
					1 Rating		FA	FA		FAR		FA
2	1.5	USFS	7	2	2 Desired	5 / 19	20 / 40	0 / 4	<20	17.8	64.0	Passage
					2 Current	8	81	4	NA	22.2	72.0	Passage
					2 Rating	FAR	FA	FA		FAR		FA
3	0.9	USFS	6	2	3 Desired	**	24 / 47	0 / 4	<20	17.8	64.0	Passage
					3 Current	1	132	1	20	NA	NA	Barrier
					3 Rating		FA	FAR	FAR			FI
4	1.1	USFS	5	2	4 Desired	**	29 / 56	0 / 5	<20	17.8	64.0	Passage
					4 Current	5	115	1	NA	NA	NA	Passage
					4 Rating		FA	FAR				FA
5	0.8	USFS	4	1	5 Desired	**	36 / 70	0 / 7	<20	17.8	64.0	Passage
					5 Current	1	131	0	NA	NA	NA	Passage
					5 Rating		FA	FAR				FA
6	0.5	Private	4	1	6 Desired	**	36 / 70	0 / 7	<20	17.8	64.0	Passage
					6 Current	0	133	4	NA	NA	NA	Passage
					6 Rating		FA	FAR				FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FI – Functioning Inappropriately
NA – Information Not Available; ** - Habitat element not applicable for this reach
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

1. Large Woody Debris (LWD)

Reaches 1, 3, 4, 5, and 6 were not rated for LWD because they are primarily low gradient meadow sites where little LWD is expected. Although a few pieces of LWD do occur within each of these reaches, except Reach 6, recruitment of LWD is quite limited. On the other hand, LWD recruitment potential was greater along the forested portions of Reach 2, yet LWD was below desired numbers, receiving a **functioning appropriately but-at-risk** rating.

In reaches 1, 3, 4, 5, and 6, only small sections of the stream are in areas where conifers can reach the channel, explaining the low LWD numbers. In Reach 2, there is a mix of both meadow and forested areas, which makes rating this reach for LWD questionable since calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are

forested. This helps to explain the intermittent nature and relatively low numbers of in-stream wood, however, professional judgment was used to determine that adequate recruitment potential does exist within this reach to attain desired numbers.

2. Pools

All of the reaches surveyed were found to be **functioning appropriately**, with pool numbers exceeding the 75th percentile. It should be noted that several of these reaches received functioning appropriately ratings even though riparian vegetation and/or channel morphology received functioning appropriately but-at-risk ratings. Of these reaches, only reaches 1 and 2 are **functioning appropriately** in terms of the large pool component, while fewer deep (large) pools were found in the other reaches, all of which received **functioning appropriately but-at-risk** ratings for large pools.

In the six reaches of Watson Creek, pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are similar to desired conditions. Reaches 1 and 2 appear to be providing adequate large pool habitat, with pool complexity occurring through depth, structure and undercut banks. An important insight for Reach 1 is the role beaver dams play in creating many of the deep pools found within the reach. Although beaver dams are the primary reason for the high number of large pools in Reach 1, the survey was also taken during a period of higher flows, possibly contributing to the high large pool numbers. This same type of complexity does not seem to exist among the pools in the remaining reaches, even though stream channels and riparian vegetation are similar to desired conditions. In portions of these reaches, riparian vegetation and stream channels conditions are still on the path of recovery towards their desired state, with stream channels being a little wider than their potential. With late-seral riparian vegetation promoting continued recovery, improved channel integrity and lower width-to-depth ratios should result – conditions that promote deep and complex pools. One additional note is that in many of these reaches, the number of deep pools is likely to remain low with the absence of beaver dams.

3. Spawning Gravel Fines

Twenty percent fine sediments were documented at the sampling site located in Reach 3, promoting 74% embryo survival. This element was therefore given a **functioning appropriately but-at-risk** rating.

The relatively low sediment levels recorded in Reach 3 (values are very close to functioning appropriately levels) are most likely attributed to the high bank stability, the abundance of late-seral vegetation, and appropriate stream types. Although roads and upstream bank instability (primarily reaches 4 and 5) are contributing to sediment levels, this reach is able to efficiently capture and transport the sediment produced by the subwatershed. Also, reported values are likely associated with the naturally high erosion rates associated with soils and geomorphology of the area.

4. Stream Temperature

Seven-day average maximum temperatures in reaches 1 and 2 were 22.9°C and 22.2°C, respectively. Based on these numbers, which are within the 17.8-24.0°C range, these two reaches are determined to be **functioning appropriately but-at-risk**. No data was available, nor were any assumptions made, for the four upstream reaches. Since Watson Creek is a significant tributary of Paradise Creek, its warmer waters (22.9°C, 3°C warmer than the station at the mouth of Paradise Creek) greatly influence downstream water temperatures. Also, based on this information, it is unlikely that much of Watson Creek provides stream temperatures (rearing) that are favorable for bull trout.

The relatively open meadow and forest/meadow setting of Watson Creek provides fairly low shade levels that ascribe to the relatively high stream temperatures found in the lower two reaches (>22.2°C). Stream temperatures, however, may be near their potential in part because stream channels and riparian vegetation are near their desired conditions – only slight improvements are expected in riparian (willow communities gain structure in the older age classes) and stream channel conditions (channels may narrow slightly). This suggests that the desired temperature of 17.8°C (State Water Quality Standard) may be lower than is achievable for this stream.

5. Fish Passage (Culvert)

The one culvert surveyed along Watson Creek, which is located in Reach 3, was identified as a barrier to fish passage. Refer to Figure 5.2 - Upper Sycan Watershed Road Locations. This culvert has a vertical jump (water surface to culvert outlet) of less than 1 foot (0.5 feet), has a pool 5 feet deep at its outlet, but has flow velocities that exceed sustained swimming speeds for trout. For this reason, this culvert is considered a barrier, and because it is in the lower part of the stream, this element receives a **functioning inappropriately** rating.

The slope (just over 4%) of the culvert, which produces flow velocities in the pipe that exceed sustained swimming speeds for fish, is the reason this culvert is considered a barrier.

Long Creek Subwatershed: No surveys occurred within this subwatershed. The lower portion of Long Creek is perennial, and potential trout habitat occurs downstream of Forest Road 2901, however no fish have been observed upstream of Forest Road 28. At this location, redband trout have been documented in the pool at the culvert outlet. This culvert is considered to be a potential barrier to fish passage based on velocities (during the spring months – spawning period) that exceed the sustained swimming speeds of trout. If fish use the upper portion of Long Creek above this culvert, it appears the timing of occupation is limited to spring months when sufficient flows exist. Fish do occupy the lower portion of Long Creek, but occur in lower numbers than other perennial streams within the watershed. Riffles, pools, and in-stream large wood are available, however, no stream survey information exists to be able to quantify habitat conditions. Also, beyond early summer, most of the available habitat becomes scarce due to decreased flows. For these reasons, this subwatershed is **functioning appropriately but-at-risk** in terms of fish habitat conditions.

Upper Sycan River Subwatershed: The following tables (Tables 5.15 and 5.16) summarize current and desired fish habitat conditions within the Sycan River and Skull Creek. Ratings given within these tables are based on a comparison of current and desired conditions (see desired conditions in Chapter 4 for ratings) within each of the surveyed stream reaches. Habitat conditions are summarized based on the following parameters: large woody debris, pools, spawning gravel fines, stream temperature, and fish passage. Following each table is a discussion of these ratings and the factors contributing to current conditions, as well as any trends in conditions. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

Sycan River

Table 5.15. Sycan River – Fish Habitat Elements

Reach Information					Condition	Habitat Elements						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Fish Passage (Culvert)
						50% / 75%	50% / 75%	50% / 75%		(°C)	(°F)	
1	2.3	USFS	38	2	1 Desired	1 / 3	4 / 6	0 / 1	<20	17.8	64.0	Passage
					1 Current	3	21	23	24	19.8	67.6	Passage
					1 Rating	FAR	FA	FA	FAR	FAR		FA
2	1.6	USFS	39	2	2 Desired	3 / 12	4 / 6	0 / 1	<25	17.8	64.0	Passage
					2 Current	8	26	18	NA	NA	NA	Passage
					2 Rating	FAR	FA	FA		FAR		FA
3	1.3	USFS	32	3	3 Desired	3 / 14	5 / 7	0 / 1	<25	17.8	64.0	Passage
					3 Current	6	45	13	NA	NA	NA	Passage
					3 Rating	FAR	FA	FA		FAR		FA
4	4.3	USFS	36	3	4 Desired	3 / 12	4 / 6	0 / 1	<25	17.8	64.0	Passage
					4 Current	12	28	22	NA	19.6	67.3	Passage
					4 Rating	FAR	FA	FA		FAR		FA
5	1.9	USFS	30	3	5 Desired	4 / 15	5 / 8	0 / 1	<25	17.8	64.0	Passage
					5 Current	22	32	19	NA	NA	NA	Passage
					5 Rating	FA	FA	FA		FAR		FA
6	0.8	USFS	30	2	6 Desired	1 / 4	5 / 9	0 / 1	<20	17.8	64.0	Passage
					6 Current	16	22	5	14	NA	NA	Passage
					6 Rating	FA	FA	FA	FA	FAR		FA
7	1.9	USFS	24	1	7 Desired	1 / 6	6 / 12	0 / 1	<20	17.8	64.0	Passage
					7 Current	11	32	8	NA	NA	NA	Passage
					7 Rating	FA	FA	FA		FAR		FA
8	1.5	USFS	22	3	8 Desired	5 / 20	7 / 11	0 / 1	<25	17.8	64.0	Passage
					8 Current	24	29	3	NA	NA	NA	Passage
					8 Rating	FA	FA	FA		FAR		FA
9	2.4	USFS	22	2	9 Desired	5 / 20	7 / 11	0 / 1	<25	17.8	64.0	Passage
					9 Current	22	55	14	NA	NA	NA	Passage
					9 Rating	FA	FA	FA		FAR		FA
10	1.6	USFS	20	1	10 Desired	2 / 7	7 / 14	0 / 1	<20	17.8	64.0	Passage
					10 Current	17	53	9	NA	NA	NA	Passage
					10 Rating	FA	FA	FA		FA		FA
11	0.6	USFS	17	2	11 Desired	2 / 8	8 / 16	0 / 2	<20	17.8	64.0	Passage
					11 Current	3	52	7	NA	NA	NA	Passage
					11 Rating	FA +	FA	FA		FA		FA
12	3.2	USFS	12	1	12 Desired	**	12 / 43	0 / 2	<20	17.8	64.0	Passage
					12 Current	0	48	19	20	15.9	60.6	Passage
					12 Rating		FA	FA	FAR	FA		FA
13	4.0	USFS	4	2	13 Desired	8 / 33	36 / 70	0 / 7	<20	17.8	64.0	Passage
					13 Current	8	75	1	8	15.2	59.4	Passage
					13 Rating	FA +	FA	FAR	FA	FA		FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FI – Functioning Inappropriately
NA – Information Not Available; ** - Habitat element not applicable for this reach
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

1. Large Woody Debris (LWD)

Reaches 1-4 are all appropriate sites for LWD, with ponderosa pine being the main source of in-stream wood. Within these reaches, LWD recruitment potential was determined to be adequate, yet LWD loadings were below desired numbers, receiving **functioning appropriately but-at-risk** ratings. In reaches 5-10, lodgepole pine is the main source of LWD, with levels in each reach determined to be **functioning appropriately**. Reaches 11 and 13 are both appropriate sites for LWD, however, these reaches occur within areas of limited LWD recruitment potential. For this reason, both were determined to be **functioning appropriately** for this element. Reach 12 is primarily a meadow site, where LWD in not expected.

In reaches 1-4, even though existing LWD numbers are near their desired levels, recruitment potential is adequate to meet these numbers. A possible reason for the slightly reduced LWD numbers within these reaches could be attributed to the Sycan River having enough energy during high flow events to move even the larger pieces of woody debris, making it more

difficult to retain wood within the channel. Existing LWD within these reaches primarily occurs where debris jams have been created, or where pieces have been caught, or locked in place, by large boulders. In reaches 5-10, the plentiful supply of lodgepole pine adjacent to the stream provides for the ample in-stream large woody debris. Reaches 11 and 13 do not occur within a continuous forested reach but rather a meadow/forest type of environment where the stream flows through both meadow and forested areas. This helps to explain the intermittent nature and low numbers of in-stream wood, and, because calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested, professional judgment – based primarily on LWD recruitment potential – was used to determine if these reaches have appropriate levels of LWD.

2. Pools

All of the reaches surveyed within the Sycan River were found to be **functioning appropriately**, with pool numbers exceeding the 75th percentile. In addition, all of these reaches – except Reach 13 – are **functioning appropriately** in terms of the large pool component. In Reach 13, fewer deep (large) pools could be found, and this element received a **functioning appropriately but-at-risk** rating.

Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are highly similar to desired conditions. The quality of pools within the Sycan River is high, with pool complexity occurring through depth, structure, and undercut banks (C and E stream types). This is revealed by the abundance of large pools noted in all reaches, except Reach 13. In this reach, the same type of complexity does not seem to exist. This may simply be a function of the size of the stream, and/or the fact that in portions of this reach, riparian vegetation and stream channel conditions are still on the path of recovery towards their desired state, with the stream channel being a little wider than its potential. With late-seral riparian vegetation promoting continued recovery, improved channel integrity and lower width-to-depth ratios should result – conditions that promote deep and complex pools. One additional note for this reach is that deep pools may be uncommon in the absence of beaver dams.

3. Spawning Gravel Fines

Fine sediment in spawning substrates was sampled at four locations within the Sycan River. The site in Reach 1, a C stream type, has 24% fine sediments, promoting 65% embryo survival. In Reach 6, also a C stream type, the percent fines were lower at 14, promoting 84% embryo survival. Thus Reach 1 is **functioning appropriately but-at-risk**, while Reach 6 is **functioning appropriately**. Reach 12, an E/C stream type, has 20% fine sediment – promoting 74% embryo survival and resulting in a **functioning appropriately but-at-risk** rating. At the uppermost sampling station, located in Reach 13 (also a E stream type) the percent fines were measured to be 8%, the lowest recorded at any monitoring station, promoting 95% embryo survival and resulting in a **functioning appropriately** rating.

The higher sediment levels found at the sampling station in Reach 1 are probably associated with the bank instability found within this reach. Also, it is highly possible that the elevated number of roads and stream crossings found throughout the entire watershed may be influencing sediment levels within this reach. The relatively low sediment levels found at the other sampling locations are most likely attributed to the high bank stability, the abundance of late-seral vegetation, and appropriate stream types. Although roads and upstream bank instability are contributing to sediment levels, these stream reaches are able to efficiently capture and transport the sediment produced by the watershed. The higher values reported in Reach 9, although values are very close to functioning appropriately levels, are unexpected since road crossings and bank instability are minimal upstream from the sampling location. Reported values could be associated with the naturally high erosion rates associated with soils and geomorphology of the area. A note of interest from the sediment sampling that has occurred within the watershed is the two-fold difference in values between 1999 and 1996. This difference is likely attributed to the flushing of fine sediments out of the system associated with the flood of 1997, one of the largest on record.

4. Stream Temperature

Based on stream temperature recordings in reaches 1, 4, 12, and 13, it is assumed that reaches 1-9 are **functioning appropriately but-at-risk**, because the 7-day average maximum temperatures were within, or assumed to be within the 17.8-24.0°C range. In contrast, reaches 10-13 are believed to be **functioning appropriately**, based on the 7-day average maximum temperatures being below 15.9°C. Based on this information, only the upper reaches of the Sycan River have

stream temperatures (rearing) that are favorable for bull trout. However, several other streams within the Upper Sycan River subwatershed also have stream temperatures favorable to bull trout. These include: Rock Creek (15.3°C), Boulder Creek (11.9°C), South Fork Sycan River (13.7°C) and Rifle Creek (12.4°C in the upper portion and 16.5°C in the lower portions).

The relatively low stream temperatures found throughout the Sycan River are a result, in part, of upstream (including main tributaries) riparian vegetation and stream channels being near their desired state. For this reason, stream temperatures may also be near their potential with only slight improvements expected in riparian (willow communities gain structure in the older age classes) and stream channel conditions (channels may narrow slightly). As discussed in previous subwatershed evaluations, several of the low-gradient reaches in the Sycan River and its major tributaries have been affected by at least one factor influencing stream temperatures. This includes such factors as: stream channels that are slightly wider than desired, loss of riparian and upland shade, lower stream flows caused by increased evapotranspiration, etc. With continued improvement in riparian and stream channel conditions, shading and a narrowing of stream channels could result in slightly lower stream temperatures. However, even though it is assumed that stream temperatures in the Sycan River were historically lower than they are today, it is questionable as to whether or not current state standards can be achieved.

5. Fish Passage (Culvert)

Only one culvert was surveyed along the Sycan River, which is located in Reach 13 at Forest Road 28 (refer to Figure 5.2 - Upper Sycan Watershed Road Locations). This culvert is <u>not</u> considered a barrier to fish passage, and thus a this element receives a **functioning appropriately** rating. It should be noted, however, that the seven other culverts surveyed within the Upper Sycan River subwatershed (refer to Figure 5.2 - Upper Sycan Watershed Road Locations) were all found to be potential barriers to fish passage. Five of these culverts are found in small tributary streams that have only a limited amount of habitat upstream of the culverts. The other two are located at the lower end of Rifle and Rock Creeks, both of which have adequate upstream habitat. For this reason, the subwatershed as a whole receives a **functioning appropriately but-at-risk** rating.

The slope (0.8%) of the culvert in Reach 13 provides acceptable velocity passage for adults. The slope of the other seven culverts is much steeper, which, based on their size and length, contribute to flow velocities in the pipes that are higher than sustainable for fish. For this reason, these culverts are considered barriers to fish passage (the culvert on Kelley Creek also has a 1 foot jump height).

<u>Skull Creek</u>

Table 5.16. Skull Creek – Fish Habitat Elements

Reach Information					Condition	Habitat Elements						
Reach	Reach Length (miles)	Owner	Desired Wetted Width (')	Gradient (%)	Reach	LWD/ Mile	Pools/ Mile	Large Pools/ Mile	Spawning Gravel Fines (%)	Stream Temperature		Fish Passage (Culvert)
						50% / 75%	50% / 75%	50% / 75%		(°C)	(°F)	
1	1.4	USFS	4	1	1 Desired	8 / 33	36 / 70	0 / 5	<20	17.8	64.0	Passage
					1 Current	22	209	0	NA	17.5	63.5	Passage
					1 Rating	FA +	FA	FAR		FA		FA
2	0.4	USFS	4	<1	2 Desired	8 / 33	36 / 70	0 / 5	<20	17.8	64.0	Passage
					2 Current	11	195	0	NA	NA	NA	Pot. Barrier
					2 Rating	FA +	FA	FAR		FA		FI
3	1.9	USFS	3	<1	3 Desired	**	48 / 93	0 / 9	<20	17.8	64.0	Passage
					3 Current	4	183	3	NA	17.5	63.5	Passage
					3 Rating		FA	FAR		FA		FA
4	1.1	USFS	3	<1	4 Desired	**	48 / 93	0 / 9	<20	17.8	64.0	Passage
					4 Current	6	168	0	NA	NA	NA	Passage
					4 Rating		FA	FAR		FA		FA
5	1.1	USFS	3	2-4	5 Desired	11 / 44	51 / 77	0 / 9	<20	17.8	64.0	Passage
					5 Current	19	174	0	NA	NA	NA	Passage
					5 Rating	FA +	FA	FAR		FA		FA
6	0.5	USFS	1-2	2-4	6 Desired	16 / 66	51 / 116	0 / 11	<20	17.8	64.0	Passage
					6 Current	6	138	0	NA	NA	NA	Passage
					6 Rating	FA +	FA	FAR		FA		FA

FA – Functioning Appropriately, FAR – Functioning Appropriately but-at-Risk, FI – Functioning Inappropriately
NA – Information Not Available; ** - Habitat element not applicable for this reach; + - Rating modified based on reach characteristics
Habitat Abbreviations and Explanations: LWD – Large Woody Debris; Large Pools – Pools > 2.6 feet deep; % Spawning Gravel Fines - <6.4mm

1. Large Woody Debris (LWD)

Like many of the other surveyed stream reaches within the Upper Sycan Watershed, Skull Creek is primarily a low-gradient meadow stream that occasionally meanders near the edge of the lodgepole pine forest. For this reason, LWD was noted in all of the reaches, but numbers were lower than expected because of limited LWD recruitment potential. Considering the nature and setting of the stream, all five of these reaches were determined to be **functioning appropriately** for this element.

As mentioned above, Skull Creek flows through both meadow and forested areas, which helps to explain the intermittent nature and low numbers of LWD found within the six reaches. For this reason, LWD ratings within these reaches are questionable, since calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested. Professional judgment – based primarily on LWD recruitment potential – was used to determine that all reaches have appropriate levels of LWD.

2. Pools

All of the reaches surveyed were found to be **functioning appropriately**. Although all reaches have pool numbers exceeding the 75th percentile, large pools were documented in only one of the reaches, Reach 3; thus all of which received **functioning appropriately but-at-risk** ratings for the large pool habitat element.

Pool frequencies reflect near-natural numbers in part because stream channels and riparian vegetation are highly similar to desired conditions. Complexity of these pools, however, appears to be lacking – with reference to depth, structure, undercut banks, etc. As previously noted, surveyors documented bank trampling by livestock in several of the reaches, which may be affecting the quality (undercut banks, cover, and pool depth) of pool habitat. As with other smaller streams in the Upper Sycan Watershed, the number of deep pools within Skull Creek may remain low with the absence of beaver dams.

3. Spawning Gravel Fines

Sediment samples were not taken within any reach of Skull Creek, and therefore, a rating could not be determined for this stream.

It is assumed that sediment samples would be fairly low within Skull Creek based on the high bank stability values, abundance of late-seral vegetation, and appropriate stream types that are found throughout the system. Like many of the other streams within the watershed, roads are likely contributing to higher than natural sediment levels, although properly functioning riparian areas and stream channels should be able to efficiently capture and transport the sediment produced within its catchments boundary.

4. Stream Temperature

Based on stream temperature recordings in reaches 1 and 3 (7-day average maximum temperatures of 17.5°C were recorded at both locations) it is assumed that all reaches are below 17.8°C, and thus are **functioning appropriately**. However, only the upper reaches of Skull Creek are considered to have stream temperatures (rearing) that may be favorable for bull trout.

The relatively low stream temperatures found throughout Skull Creek are a function of upstream riparian vegetation and stream channels being near their desired state. This has led to shading levels (shade information was collected within all reaches of Skull Creek using a solar pathfinder) that are also close to their desired conditions. For each surveyed reach, shading values were compared to data collected – for reaches determined to be near their desired or potential condition – within the Sprague River system (data from information for the Sprague River TMDL – unpublished). Comparisons were made utilizing information from streams of the same width and riparian community group. Shading levels within Skull Creek were found to be within the range of values for similar sites that are at or near their potential condition within the Sprague River System. Shading values for Skull Creek were as follows: (R1) 54%, (R2) 59%, (R3) 31%, (R4) 54%, (R5) 60%, and (R6) 29%.

5. Fish Passage (Culvert)

Two culverts were surveyed along Skull Creek, one located in Reach 2 and the other in Reach 3. Only the culvert in Reach 2 is considered to be a potential barrier to fish passage. For culvert locations refer to Figure 5.2 - Upper Sycan Watershed Road Locations. Both of these culverts have acceptable jump heights and pools at the outlet of the culvert, but velocities in the culvert at Reach 2 were determined to slightly exceed the sustainable swimming speeds of trout. Because this culvert occurs in the lower portion of the stream, this assessment element receives a **functioning inappropriately** rating.

The culvert in Reach 1 has a slope that is essentially flat, which produces low velocities that allow for fish passage. The slope of the culvert in Reach 2, however, is steeper (1.8%), which, based on the size and length of the culvert, contribute to flow velocities in the pipe that are slightly higher than sustainable for fish. For this reason, this culvert is considered a barrier to fish passage (or at a minimum it creates conditions difficult for passage), although a more detailed evaluation is needed to affirm this determination.

Watershed Summary - Habitat for Aquatic Species

Approximately 55 miles of stream were surveyed within two of the three subwatersheds and were distributed in the following manner: Paradise Creek (9 miles); Crazy Creek (7 miles); Watson Creek (6 miles); Sycan River (27 miles); Skull Creek (6 miles). The following is a short summary of fish habitat conditions within the entire Upper Sycan Watershed. For reach locations refer to Figure 5.3 - Upper Sycan River Watershed Reach and Monitoring Locations.

1. Large Woody Debris (LWD)

Of the 41 reaches surveyed, 28 are appropriate sites for LWD while the remaining 13 are primarily meadow sites where LWD in not expected. Of the 28 reaches that were determined appropriate for LWD ratings, 13 are in forested areas where calculated numbers were used to determine ratings, while the other 15 occurred in a mix of meadow and forest areas where professional judgment was used to determine if reaches had appropriate levels of LWD. Of the 13 reaches that are forested, 7 (54%) are **functioning appropriately**, while the remaining 6 (46%) are **functioning appropriately but-at-risk**. The meadow/forest reaches were all determined to be **functioning appropriately**. The majority of the forested reaches are B stream types, with a few C and E stream types. The meadow/forest reaches were all E and C stream types.

As mentioned in the individual stream summaries, many of the surveyed reaches within the watershed flow through both meadow and forested areas, which helps to explain the intermittent nature and low numbers of LWD found in these reaches. For this reason, LWD ratings within these reaches were questionable, since calculations that lead to desired numbers of LWD assume that nearly all areas along the stream are forested. Professional judgment – based primarily on LWD recruitment potential – was used to determine that all reaches have appropriate levels of LWD. Most of the forested reaches within the watershed have adequate numbers of LWD, in part, due to the low levels of harvesting that have occurred near stream channels.

2. Pools

Of the 41 reaches surveyed, 40 (98%) are **functioning appropriately** for pool numbers, while the remaining reach is **functioning appropriately but-at-risk**. All of the stream reaches surveyed within Crazy Creek, Watson Creek, Sycan River and Skull Creek are functioning appropriately, with only one reach of Paradise Creek **functioning appropriately but-at-risk**. Of the reaches surveyed, only 17 (41%) are **functioning appropriately** in terms of the large pool component, with fewer pools found in the other 24 reaches, all of which received **functioning appropriately but-at-risk** ratings. The percent of reaches, for each stream surveyed, that meet desired large pool numbers include the following: Paradise Creek (33%), Crazy Creek (0%), Watson Creek (33%), Sycan River (92%), and Skull Creek (0%).

Pool frequencies reflect near-natural numbers, for the most part, because stream channels and riparian vegetation are highly similar to desired conditions throughout the watershed. In other words, the majority of the stream reaches surveyed are lined with late-seral vegetation that contribute to appropriate stream types and width-to-depth ratios, factors that contribute to desired pool numbers. The reach that was not determined to be functioning appropriately has riparian vegetation and stream types that are not at desired levels.

The quality of pools within the larger streams (Sycan River and Paradise Creek) is high, with pool complexity occurring through depth, structure, and undercut banks (C and E stream types). This is revealed by the abundance of large pools noted in many of the reaches. Beaver dams are considered the primary reason for the high number of large pools found in the lower reach of Watson Creek. This same type of complexity appears to be lacking in many of the other streams or stream reaches within the watershed. This may simply be a function of the small size of many of the streams within the watershed and/or the fact that in portions of these streams, riparian vegetation and stream channel conditions are still on the path of recovery towards their desired state, with the stream channels being a little wider than their potential. With late-seral riparian vegetation promoting continued recovery, improved channel integrity and lower width-to-depth ratios should result – conditions that promote deep and complex pools. One additional note, for the smaller streams within the watershed, is that deep pools may be uncommon in the absence of beaver dams – Reach 1 of Watson Creek serves as an example of how beaver dams can influence the number of large pools in small streams.

3. Spawning Gravel Fines

Of the 11 sites measured for spawning gravel fines (1999 sampling only), 6 (55%) are **functioning appropriately**, 4 (36%) are **functioning appropriately but-at-risk**, while 1 was found to be **functioning inappropriately**.

In general, the low to moderate sediment values found throughout the watershed are likely attributed to high bank stability, abundance of late-seral vegetation, and appropriate stream types. Even though roads may be contributing sediment into streams, the appropriate stream types can efficiently transport the sediment through the channel and capture it on the adjacent floodplain. This process would apply primarily to those areas where riparian vegetation and stream types are found to be functioning appropriately.

The higher sediment values documented at the lower end of the watershed (Reach 1 of the Sycan River) are likely a function of the cumulative effects from sedimentation associated with the increased drainage network and isolated bank instability. The Upper Sycan River subwatershed has the highest Road Impact Index, and the monitoring site is located downstream of areas with bank instability. The high values reported in Reach 5 of Crazy Creek were unexpected since road crossings and bank instability are minimal upstream from the sampling location. One possible explanation is that the sample was taken at the lower end of a low gradient meadow reach, which may act as a natural settling point for fine sediment. In addition, reported values are likely associated with the naturally high erosion rates associated with soils and geomorphology of the area, and noted just above the sampling site was one of the few areas of localized bank instability.

As stated previously, there is a two-fold difference in sediment values between 1999 and 1996 (two locations have such data), which is likely attributed to the flushing of fine sediments that occurred associated with the flood of 1997, one of the largest on record. Furthermore, beaver are no longer a significant influence in watershed streams with few dams present to trap sediments. It is assumed that higher numbers of beaver dams would help reduce sediment levels in watershed spawning gravels.

4. Stream Temperature

Of the 41 reaches surveyed, 37 were rated for stream temperature. Of these reaches, 20 (54%) are **functioning appropriately**, while the remaining 17 (46%) are **functioning appropriately but-at-risk**. The entire length of both Crazy and Skull Creeks are rated functioning appropriately, however, only the upper reaches of these streams are considered to have stream temperatures (rearing) that may be favorable for bull trout. The majority of the reaches in the other three surveyed streams were rated as functioning appropriately but-at-risk, with only the upper reaches of Paradise Creek and the Sycan River providing suitable stream temperatures for bull trout (it is unlikely that much of Watson Creek provides stream temperatures (rearing) that are favorable for bull trout). Other streams within the watershed with stream temperatures favorable to bull trout include: Rock Creek (15.3°C), Boulder Creek (11.9°C), South Fork Sycan River (13.7°C) and Rifle Creek (12.4°C in the upper portion and 16.5°C in the lower portions).

For Crazy and Skull Creeks, and other watershed reaches that are functioning appropriately, water temperatures may be near their potential because stream channels and riparian vegetation are near their desired state. Several of the stream reaches that are functioning appropriately but-at-risk, occur in, or downstream of, low gradient meadow reaches. In these reaches, the relatively open meadow and forest/meadow setting provides fairly low shade levels that ascribe to higher stream

temperatures. In addition, large willows are lacking along many of these meadow reaches – late season grazing is probably a major contributor to the lack of willow in these meadow environments – and a number of these reaches have width-to-depth ratios that are slightly higher than desired, which increases the water surface area exposed to solar radiation.

Overall, the relatively low stream temperatures found throughout the Upper Sycan River Watershed are a function of riparian vegetation and stream channels being near their desired state. For this reason, stream temperatures may also be near their potential with only slight improvements expected in riparian (willow communities gain structure in the older age classes) and stream channel conditions (channels may narrow slightly). As discussed in previous subwatershed evaluations, several of the low-gradient reaches within the watershed have been affected by at least one factor influencing stream temperatures – stream channels that are slightly wider than desired, loss of riparian and upland shade, lower stream flows caused by increased evapotranspiration, etc. With continued improvement in riparian and stream channel conditions, shading and a narrowing of stream channels could result in slightly lower stream temperatures. However, even though it is assumed that stream temperatures were historically lower than they are today, it is questionable as to whether or not current state standards can be achieved in all streams.

5. Fish Passage (Culvert)

Only one of the streams surveyed – Sycan River – is **functioning appropriately** for fish passage (although the subwatershed was rated **functioning appropriately but-at-risk**). The other four streams are **functioning inappropriately**, because culverts in the lower reaches of the stream are determined to be barriers to fish passage.

In most cases culverts are barriers because they were installed with steep slopes that result in higher than sustainable swimming velocities for trout. In a few cases, culverts also have vertical jumps (water surface to culvert outlet) of 1 foot or greater.

Key Question 4: How are the above subwatershed conditions influencing redband trout viability?

Watershed Summary

For this assessment, native trout viability is used as an indicator for watershed health, being linked to upland, riparian, and channel conditions. If watershed conditions are conducive to long-term native trout viability, then the desired watershed attributes should occur across the landscape. Those attributes include good water quality, high forage production, and good fish and wildlife habitat.

Under current conditions described in this document, all of the streams and subwatersheds are **functioning appropriately but-at-risk** for the long-term viability of native trout populations. Thus, the entire Upper Sycan River Watershed also receives a **functioning appropriately but-at-risk** rating for native trout viability. Recognizing the connection between uplands, riparian areas, stream channels, and habitat for native trout, the following reasons support this rating.

Dense forest stands are one factor contributing to the watershed/subwatersheds functioning appropriately but-at-risk. A portion of the watershed's forest stands have fairly dense understories resulting from nearly 100 years of fire exclusion. Prior to the early 1900's, the natural fire return interval maintained relatively open forest stands with little understory fuels to carry a fire from the ground to the canopy layers. Once intensive timber harvest began in the 1950's, old growth trees within these stands were usually removed through clearcutting or selective harvest, converting slower growing stands into faster growing wood producing sites. This left the landscape in a matrix of dense and early-to-mid-seral stands, leaving the dense canopies at high risk of catastrophic fire which could result in added sediment and altered flow regimes in watershed streams. If stands remain in their current condition, the question is not "Will these dense forests burn?" but "When will they burn?"

In addition, fire exclusion has permitted conifers to expand into meadows and other riparian areas, promoting competition with riparian plants (sedge, rush, willows, aspen, cottonwood, and alder) necessary to maintain bank stability and proper stream types. In addition, junipers are slowly expanding into the drier, deeper-soil pine sites in the western portion of the watershed. This continued expansion could lead to more areas in juniper woodlands, replacing other native vegetation types, leaving the soils prone to erosion, and probably reducing late summer stream flows.

High road densities are a major reason why the watershed is functioning appropriately but-at-risk for native trout viability. Most of the roads within the watershed were constructed to provide access for recreation and the vast timber resources within the area, with many that parallel and/or cross, stream channels. Additionally, the effects of management activities on soil resources has been fairly extensive throughout the watershed, a result of past timber harvest activities. The resulting road network and detrimental soil compaction have likely modified the timing, magnitude, and frequency of peak flows, flows that can prevent natural healing of unstable banks, as well as influencing the amount of sediment reaching stream channels, sediment that can fill spawning gravels and pools.

Both vegetation/bank stability and Rosgen stream types support the functioning appropriately but-at-risk rating for native trout viability throughout the watershed. Survey results documented that about 78% of the riparian vegetation and associated bank stability is functioning appropriately throughout the watershed, suggesting that most current management practices promote late-seral vegetation required for high bank stability. Further, the predominance of late-seral riparian vegetation in the watershed appears strongly correlated to the abundance (about 78%) of Rosgen stream types that are functioning appropriately. As previously mentioned in this chapter, Rosgen B stream types are abundant across the watershed and are anchored by alder, willow, sedge, and conifers. The abundance of E and C stream types throughout the watershed is directly tied to sedge, rush, and to a lesser degree, willow. In a few locations within the watershed, such as the lower reaches of the Sycan River and portions of Paradise Creek, the cumulative effects of past land management activities – mainly the effects of roads – along with continued livestock grazing, may be negatively influencing the ability of the stream channel to revegetate and form stable banks.

The predominance of late-seral riparian vegetation and appropriate stream types has led to high pool numbers throughout the watershed streams. Pool frequencies reflect near-natural numbers, for the most part, because stream channels and riparian vegetation are highly similar to desired conditions throughout the watershed. In other words, the majority of the stream reaches surveyed are lined with late-seral vegetation that contribute to appropriate stream types and width-to-depth ratios, factors that contribute to desired pool numbers. The quality of pools within the larger streams (Sycan River and Paradise Creek) is high, with pool complexity occurring through depth, structure, and undercut banks (C and E stream types). Within the E and healthy C stream types, pools are complex – relatively deep with undercut banks. However, in the C stream types that lack sedge and willow, and have higher width-to-depth ratios, pools are lacking undercut banks that provide fish cover. In the B stream types throughout the watershed, LWD levels play an important role in enhancing pool complexity, increasing the ability of watershed streams to capture and store sediment, especially in the event of a catastrophic fire, which can place spawning habitat at risk of sedimentation.

This same type of complexity appears to be lacking in many of the other streams or stream reaches within the watershed. This may simply be a function of the small size of many of the streams within the watershed and/or the fact that in portions of these streams, riparian vegetation and stream channel conditions are still on the path of recovery towards their desired state, with the stream channels being a little wider than their potential. With late-seral riparian vegetation promoting continued recovery, improved channel integrity and lower width-to-depth ratios should result – conditions that promote deep and complex pools. One additional note, for the smaller streams within the watershed, is that deep pools may be uncommon in the absence of beaver dams – Reach 1 of Watson Creek serves as an example of how beaver dams can influence the number of large pools in small streams.

An additional reason for placing native trout viability in the functioning appropriately but-at-risk category are the higher stream temperatures found in the mid to lower portions of Paradise Creek, Watson Creek, and the Sycan River. These temperatures can be stressful to native fish, negatively affecting growth and development. Areas where these temperatures occur are within, or downstream of, low gradient meadow or forest/meadow reaches, which have fairly low shade levels that ascribe to higher stream temperatures. In addition, large willows that could provide shade are lacking along many of these meadow reaches – late season grazing is probably a major contributor to the lack of willow in these meadow environments. Also, a number of these reaches have width-to-depth ratios that are slightly higher than desired, which increases the water surface area exposed to solar radiation.

Finally, culvert barriers exist throughout the watershed, disrupting connectivity and inhibiting free movement of native trout within and amongst streams within each of the subwatersheds, movement necessary for spawning, access to cool water refugee, and immigration from degraded habitat into good habitat.

In conclusion, riparian vegetation/bank stability, Rosgen stream types, and pool numbers have good overall ratings. The remaining elements, however, need improvement: high canopy closure in forested sites, expansion of juniper, moderate road densities, moderate stream temperatures, moderate to high spawning gravel fines, and culvert barriers. Currently, the less

than desired conditions of these remaining elements inhibit the Upper Sycan River Watershed from functioning appropriately as a native trout reserve and as a result, the watershed is **functioning appropriately but-at-risk**.

II. Vegetation

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?

3. What rare or designated sensitive plants occur in the watershed?

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?

Forested Uplands

The two main contributors to the difference between current and reference conditions of the forested communities are timber harvest methods, and the alteration of the natural fire regime. Effects of insects and diseases are tightly connected to these two overwhelming forces.

1. Timber Management

Protection and widespread harvest of valuable large ponderosa pine has led to a change in landscape patterns, species composition, stand structure, and resistance to insects and diseases. What were extensive, open and park like stands of ponderosa pine have turned into dense, multistory structures with weakened overstories and high fuel levels. Conifer seedlings and shrubs have replaced grass species that co-evolved with frequent fires. Mixed conifer stands have closed into more homogenous structures with a species composition shift to white fir. Fine fragmentation has shifted to coarse and blocky due to the intensive forestry practices of even-aged management, namely overstory removals and clear-cutting. Seral stage distribution has shifted from one of being within stand to aggregations among stands.

With the pressure of fire protection and early grazing practices, dense understories began to develop under ponderosa pine canopies. These understories were pine and juniper at the lower/drier end and white fir at the upper/wetter end. Conifers have steadily encroached into meadows and riparian areas causing negative effects to other resources. Following WWII, harvest intensity ran the spectrum from removal of single "high risk" trees (in order to capture the mortality) to whole stands overstory removal. The fine scale fragmentation inherent within these stands was being replaced with a coarser "blocky" fragmentation. Early seral components within the larger historic stands were becoming their own stands. Species composition was changing from pure ponderosa to a mixed assortment heavy to the shade tolerant white fir with unregulated stocking. Due to the opportunistic nature of capturing mortality, many stands were being entered two and three times. Few stands can be walked today without seeing old skid trails leading to large ponderosa pine stumps. Unacceptable levels of soil compaction are being observed across many areas. Basalt derived soils are at highest risk. Volcanic derived soils seem more resistant. More recent clear-cutting and micro management of stands has further drawn the landscape into coarser, "blocky" patterns

2. Insects and disease

Recent symptoms of poor forest health are being blamed on the combination of multiple entries, unregulated densities and transitions to shade tolerant species. Increases in the virulence of annosus and armillaria root diseases are linked to soil compaction, unregulated density and an increase of host species (white fir). Dwarf mistletoes have expanded, in part, due to the creation of multi-storied stands of a single species (results of partial overstory removals).

3. Fire Ecology

The alteration of the natural fire regime has affected ponderosa pine types at the regional scale. A fire management strategy in effect during most of the 20th century that included prevention, detection, and suppression altered a reference condition fire ecology which had promoted the development of the open parklike stands. The speed at which stands have shifted from single to multistory structures seems remarkable until one realizes that on average, based on historical fire return interval, up to 10 fire cycles have been deferred in ponderosa pine communities. With the change in stand structure and density comes a change in how these ecosystems are reacting to natural disturbance events. Due to the absence of "maintenance fires", wildfires today are more likely to produce "stand replacement" events. Newly developed shrub/seedling understories increase fuel loadings and create ladders into canopy crowns. Under such conditions, large, stand replacing fires are far more common than they ever were historically. The damage to the soil profile from such an event is severe and at a landscape scale. Soils may take only two to three years to recover from a light fire. An intense, hot fire that burns through the deep duff and "cooks" the soil may take centuries to recover (Pyne 1996).

Fire prevention strategy and livestock grazing has driven the most drastic changes within ponderosa pine stands. Understories of "second growth" ponderosa have developed in the absence of frequent under burns. These multistory stands are taxing the growing space provided on most sites. Only where fire has been carefully prescribed under the natural fuels program have stands been maintained in a single story structure, which was historically the norm.

Since the fire return interval in lodgepole pine forests is relatively long compared to the other forest types within the Sycan Watershed, fire exclusion has probably had the least effect in this type. However, the watershed has not experienced large-scale disturbance in at least the past 80 years. Fire behavior and intensity in lodgepole, as in other plant associations, is driven by fuel loading and continuity which are largely determined by the spatial scale of the insect disturbance. In the past, the 64,027-acre watershed probably would have experienced at least 1 fire per century averaging several thousand acres.

Higher elevation mixed conifer and lodgepole pine have not been as radically altered by fire suppression, as have the ponderosa pine and lower elevation mixed conifer. What was historically a somewhat patchy, coarse fragmentation, is today very homogenous. Stands are slowly becoming less structurally diverse, broken only by plantations and overstory removal units. In fact, not accounting for structural stage distribution, some clear-cut harvested areas resemble what a fragmentation pattern may have looked like in mixed conifer types. Mid seral structure is slowly disappearing. The future mid seral stands are still sapling-sized plantations and define the lag time in seral distribution.

4. Insects and Disease

Frequent fires functioned as a control to dwarf mistletoe infections. Fire prevention has allowed mistletoes to spread unchecked. The degree of change is linked to the number of fire cycles skipped. Therefore, expansion is most notable in ponderosa pine and high energy mixed conifer communities. Bark beetle mortality is directly related to the size class and high densities that are occurring in these post-fire dependent stands. Recent large outbreaks of fir engraver are directly related to dense white fir conditions, which are occurring at a landscape scale.

5. Old Growth, LOS and Historic Range of Variability and Old Growth Core

As reported in Step 4, page (4-10), the best information available on the historic vegetative types in the Upper Sycan Watershed comes from the 1946 and 1947 Timber Type Maps. This information can be compared with current condition to determine if current single-storied LOS is within the historic range of variability of such structure.

Old Growth Core In Upper Sycan Watershed

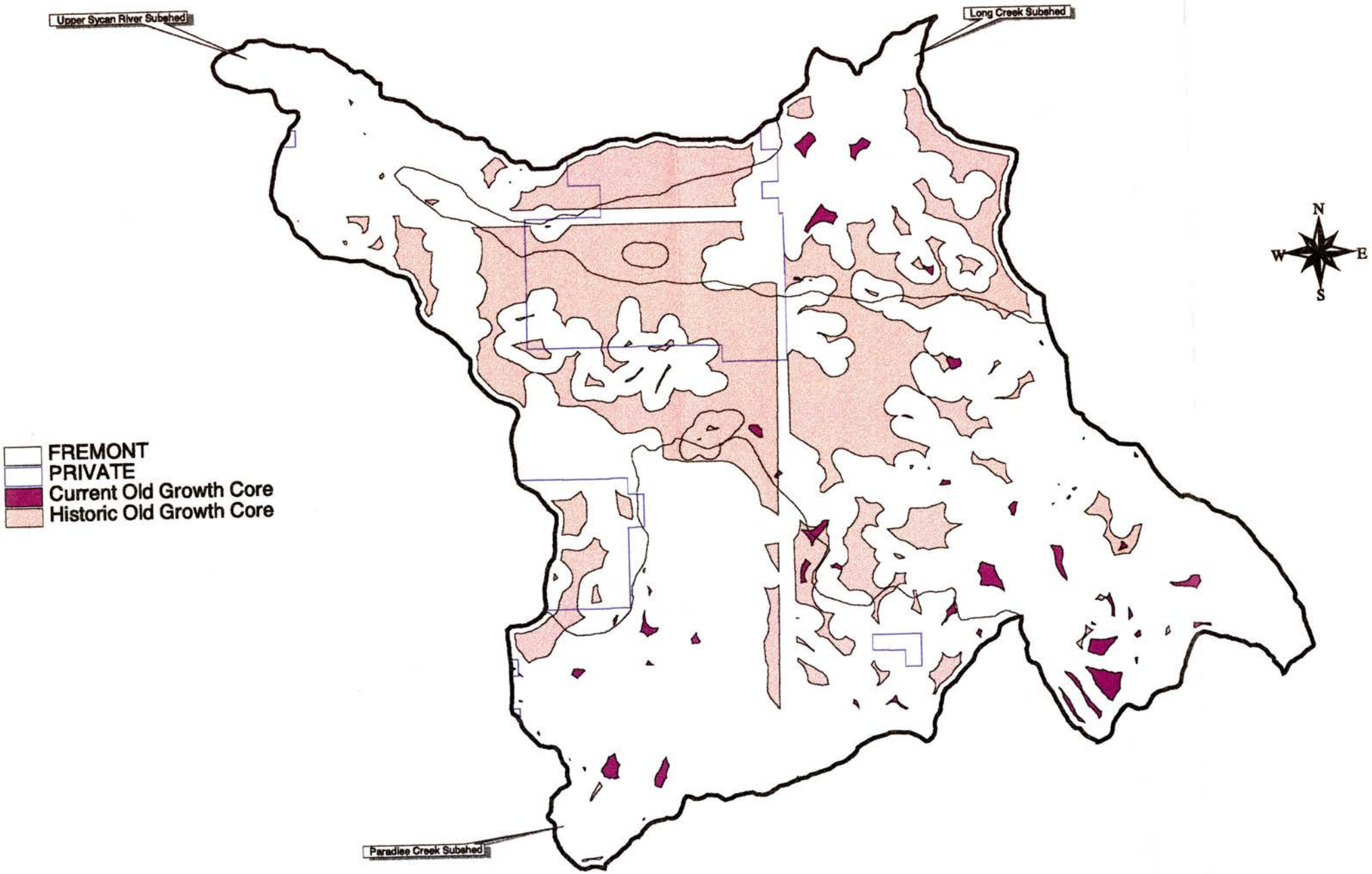


Table. 5.17 Comparison of Old Growth Conditions (Reference vs. Current)

	1946-47	Current
Old Growth Ponderosa Pine	29,600 ac. (late & old)	1,600 ac. (old)
Old Growth Pine Associated	not available	1,650 ac.
Old Growth Lodgepole Pine	2 ac.	2,900 ac.
Core Old Growth*	14,800 ac.	700 ac.

* Core old growth is defined below on page (5-33)

The Fremont National has never mapped the late seral ponderosa pine and pine associated types. This represents a data gap in the analysis. The harvest layer is also not complete. This results in a lack of data to compare historic late/old seral stages in a historical and current context with a high level of confidence. However, based on the level of agreement between 1946-47 timber types and current GIS ecoclass acreages, an adequate comparison of historic and current conditions in some areas can be made.

From the data and inspection of current stand conditions, it can be concluded that the ponderosa pine forested types are below the historic range of variability for LOS single storied stand structure. This conclusion is based on the age classes of the understory vegetation that are not presently old enough to have been a significant component of the pre-1900 stands. Hopkins describes historical old growth ponderosa pine stands (pre-1900) as having approximately 20 – 30 trees per acre in the 17 inch and larger diameter classes with fewer than 5 seedlings per acre and less than one downed log per acre. Numerous spike topped trees occurred in these stands.

Lodgepole pine is above historic range of variability for late condition. This would be expected in areas where fire suppression has been effective. Stands at higher elevations are approaching a stage of high susceptibility to Mountain Pine Beetle attack. Upon reaching 120-150 years in age, lodgepole pine stands are generally thinned from above by the beetles and in the absence of fire, the larger diameter trees remain as snags for an average of 11 to 20 years and then collapse into tangles of jackstrawed down wood. Such conditions provide excellent habitat for several woodpeckers and American marten.

The reported reductions in the amount of old growth ponderosa pine forest are also reflected in reductions of *core* old growth – see the map, *Old Growth Core In Upper Sycan Watershed*, following page (5-33). This has implications for old growth dependent species. Core area" is defined as old growth which is greater than 600 feet from patch edge. In other words, core area is old growth, buffered by at least 600 feet of old growth. Old growth core areas are of critical value in providing secure old growth dependent species habitat.

Non-Forested Uplands

Livestock grazing has contributed to the alteration of non-forested vegetation in the watershed by interrupting ecological plant succession by maintaining certain plant communities in early-mid seral condition and by hastening the pace at which other communities move toward late succession. Grazing has also affected soil stability through removal of plant cover and compaction, degraded riparian habitat and subsequent function, reduced species composition through selective plant herbivory and aided in the spread of introduced species. World War I era efforts to optimize beef and wool production had deleterious effects on the range. Exclusion of fire also led to the alteration of non-forested vegetation by permitting conifer encroachment into a variety of habitats, including aspen and riparian zones. Current range management practices within the watershed are considered adequate to sustain and/or promote riparian and upland ecosystem health. Range resource management in the watershed will be analyzed on an allotment basis in the 2000 Upper Sycan Complex Range Environmental Analysis.

Unsustainable range management practices of the past, such as uncontrolled numbers of livestock and season long use are examples of what originally altered and degraded the rangeland in the watershed. This type of management led to the problems that are evident today, such as downcut riparian systems, increases in shrub cover, introduction and establishment of exotic plant species and juniper encroachment. It wasn't until the 1960's that the main portion of the watershed was divided up into separate pastures, which enabled tighter control of livestock numbers and season of use that has allowed

range conditions to improve.

Table. 5.18 Non-forested Vegetation Condition and Trend.

	Range Condition and Trend			
Plant Association	Poor	Fair	Good	Trend
Bluegrass-dry meadow				→
Hairgrass-sedge-moist meadow				↓
Sedge-wet meadow				↓
Low sagebrush-goldenweed/bluegrass				↑
Low sagebrush/bluegrass-onespike oatgrass				↑
Low sagebrush/fescue-squirreltail				↑
Big sagebrush/bunchgrass				↓
Juniper/low sagebrush/fescue				→

1. Meadow Communities

Bluegrass dry meadow communities have been altered since reference times. Past livestock grazing detrimentally affected species composition and removed riparian vegetation necessary for bank stability. This caused stream downcutting which disconnected many dry meadows from their adjacent floodplains. As a result, this association is often represented by a more xeric range that exhibits big and silver sagebrush. Past and current grazing has kept these meadow systems in early-mid seral succession. Livestock grazing and subsequent introduction and naturalization of introduced Kentucky bluegrass have changed these meadows from reference condition. Species composition has been altered from a native bluegrass component to a Kentucky bluegrass dominated site. It may be unrealistic to perceive a return to reference condition dry meadows due to the aggressive, highly competitive nature of Kentucky bluegrass as it responds positively to grazing with vegetative reproduction (tillering). The current condition of bluegrass dry meadows is fair with a static trend (Table. 5.18). Percent cover has generally not changed and there has been an increase in palatable increaser forage species composition, mainly dryland sedges, and California oatgrass, in dry meadows since the 1960's. It is estimated that up to 80% of the dry meadows in the watershed are in mid seral succession with a small percentage in both early and late.

Hairgrass sedge moist meadows have more litter accumulations than was present in reference times which has suppressed live plant cover which indicates a downward trend on these sites that is not related to grazing use (Table. 5.18). Moist meadows were dominated by all native species such as tufted hairgrass and sedges, similar to what is present today. Species composition has changed slightly as some sites have introduced meadow foxtail as a co-dominant to tufted hairgrass. In general the hairgrass sedge moist meadow sites in this watershed are in fair forage condition and mid-late succession (Tables. 3.20b and 5.18). Moist meadows are usually grazed late in the season and as a result have not received the same intensity of use as the bluegrass dry meadows. Current livestock utilization in these meadows is typically light since these meadows tend to remain wet later in the season and have unpalatable decadent herbaceous vegetation. Periodic burning would benefit these moist meadows by maintaining higher plant densities, stimulating plant vigor and limiting conifer establishment, all of which would change the trend toward upward.

Sedge wet meadows are the most resilient to grazing of all the meadow types. Wet meadows are in good range forage condition in the watershed and are represented in late plant succession (Tables. 3.20b and 5.18). Good condition sites are dominated by wetland sedges and have a relatively thick litter layer. Sedge wet sedge meadows were dominated by wetland sedges and possibly trace amounts of hairgrass showing little deviation today from reference condition species composition. Live plant cover has decreased and litter has inversely increased, showing a trend toward late succession, which is equivalent to a downward forage trend (Table. 5.18). Ecologically these sites are moving in a natural progression without major disturbance, however late succession communities have less forage, more litter and often decadent unpalatable plants for grazing resulting in a downward trend. In the past, during drought years, grazing may have more heavily impacted this meadow type, although signs of past degradation are not evident today. Fire may have had only a restricted role in maintaining wet meadows due to the high water tables they are associated with however drought cycles would have allowed fire in this type. Lodgepole pine encroachment into wet meadows would have been restricted by fire.

2. Shrub/Bunchgrass Communities

Big sagebrush/bunchgrass associations have moved to predominantly mid-late successional communities. In reference times, shrublands would have been represented by a mosaic of age classes and community structure based on natural disturbances, like fire. Decadent sagebrush dominates this association today and shrub canopy cover has increased since reference times and dominates these sites at the expense of native bunchgrasses. Sagebrush communities are rated in fair forage condition in the watershed and have shifted ecologically toward late plant succession, which selects against herbaceous species, causing a downward forage condition trend (Table. 5.18). Fire will return big sagebrush/bunchgrass communities back to bunchgrass dominated range and move these sites toward good condition.

Grazing has altered low sage/fescue/squirreltail, low sage-goldenweed/bluegrass and low sage/bluegrass-onespike oatgrass sites by allowing shrub cover to increase over herbs and grasses. These sites generally have a low disturbance regime due to low herbage productivity (limited fuels) and plant cover. Early season grazing on wet soils may have negatively impacted the soils on these sites and exacerbated pressure on bunchgrasses, favoring a slight increase in shrubs. Low sagebrush community types appear to be in mid to late successional stage, with very little acreage in early succession. Current range condition is fair with an upward trend as shrub cover increases slowly on these sites. Reduced grazing pressure over the years, as less livestock are on the range today, has allowed bunchgrasses to recover and increase. Percent bare ground has decreased on these sites since the 1960's (Table. 5.18). Scattered juniper were present in reference times on these sites, but did not exceed more than 2-4 trees per acre. Low sagebrush sites are generally more stable sites with low disturbance and have a natural fire return interval of 100-200 years. Fire suppression has not disrupted community flux in these sites to the same extent as big sagebrush/bunchgrass communities. Juniper in low sage flats has increased slightly above reference density.

3. Juniper Communities

Juniper has expanded within and beyond the juniper/low sagebrush/fescue and the ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue association in the watershed. In reference times, periodic fires would have kept western juniper restricted to sites with poor soil development such as rocky hillsides and ridges. Factors such as a period of wet climatic conditions and the onset of fire suppression created the initial favorable conditions for juniper density to increase. Past overgrazing contributed to this expansion by reducing herbaceous ground cover, particularly fine fuels necessary to carry a fire. Juniper woodland expansion continues with the absence of a natural fire regime and negatively affects herbaceous biomass productivity. Juniper encroachment has the potential to increase soil nutrient loss, runoff and erosion in the watershed. Current range condition is fair with a static trend, as juniper has increased to a greater extent compared to low sage/bunchgrass sites. Juniper/low sagebrush/fescue sites have more trees per acre thus reducing herbaceous species composition and cover (Table. 5.18).

4. Open Forest Communities

The open pine associations such as ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue, ponderosa pine-quaking aspen/bluegrass and ponderosa pine/mountain big sagebrush/bluegrass have been affected by the interrupted fire regimes that once kept their understory vegetation in a park-like condition. Ponderosa pine communities with a big sagebrush understory were maintained in an early to mid seral condition that favored herbaceous species and a highly dispersed pine overstory. This herbaceous/forb understory ecosystem has been largely replaced with mature brush species and conifers in varying degrees of regeneration. Turn of the century grazing also attributed to this increase in seedling survival by reducing herbaceous plants ability to compete and provided favorable seedbed conditions through trampling and litter displacement. Understory forested vegetation in the ponderosa pine type exceeds historic density.

A speculative finding regarding aspen emerged from examination of the 1946-47 Timber Type data. The 1946-47 data included 1,300 acres classified as "hardwoods". Mapping of aspen stands in 1999 shows 460 acres as pure aspen, 740 acres as mixed aspen and 7,300 acres of scattered aspen throughout the watershed. Thus there are currently 1,200 acres recognized as an aspen type (sum of pure and mixed). It is probable that most of the stands classified as "hardwoods" in 1946-47 were aspen, with minor components of black cottonwood and willow in riparian areas.

Historically, aspen communities were naturally maintained by fire and possible beaver activity as both acted to stimulate vegetative regeneration. Utilization of aspen suckers in reference times would have been restricted to native herbivores in

small concentrations. Current utilization levels by domestic livestock are likely higher than levels associated with ungulate browse in reference times. Conifer encroachment into aspen stands would not have been an issue in reference times due to natural disturbance.

Noxious Weeds

Noxious weeds were not evident in the watershed during reference times. At the end of the reference time period, domestic livestock grazing, logging, road construction, and other Euro-American ground disturbing activities led to the introduction and establishment of noxious weed species in the watershed. Established weed populations, recreationists, and the resulting increased vehicle traffic in the Forest are contributing to the current spread of noxious weeds. Many of the existing populations are isolated, which helps to facilitate control; however, spread potential is high for many of these species. Prior to the completion of the 1991 Noxious Weed Control Environmental Assessment, noxious weeds were mostly treated by manual treatment methods and due to limited personnel and budgets, emphasis on weed control was minimal. A lack of comprehensive treatment management resulted in new infestations and spread of existing noxious weed sites on National Forest lands. Currently, the Forest has implemented a more integrated plan for the treatment and control of noxious weeds. Methods such as hand pulling, grubbing, cutting, mowing and chemical and biological control will be used, as directed under the 1998 Environmental Assessment for the Management of Noxious Weeds. Noxious weeds pose a threat to the health and biodiversity of forested and rangeland ecosystems on the Fremont National Forest.

Threatened, Endangered, and Sensitive Plant Species

Sensitive plants such as blue-leaved penstemon and green tinged paintbrush have been affected by canopy closure and interruption of natural disturbance factors such as fire in some locations. Blue-leaved penstemon is detrimentally affected by " deprivation of light and competition from other species when disturbance regimes are interrupted allowing overstories to exceed 40% crown closure" (Wooley 1998). Green tinged paintbrush has adapted to the disturbance regime associated with pine/sagebrush communities. This plant has a hemiparasitic relationship to the shrub community that it inhabits. With the reduced role of fire in the ecosystem, it is speculated that there may be more green-tinged paintbrush today because of more host plants than in reference times. However, the mature shrub community will probably only benefit this plant to a point before competition for sunlight, nutrients, etc. decreases the ability of green-tinged paintbrush to compete. In other areas, these species have benefited from habitat created through timber harvest activities.

III. Terrestrial Species and Habitats

Key Questions:

1. How have wildlife abundance, distribution, diversity and habitat conditions been altered?

2. What key terrestrial habitat components are scarcest or most at risk? What threatens species viability?

3. Where are the known problem areas that are contributing to reduced wildlife habitat capability?

Threatened, Endangered, and Sensitive Species

1. Northern Bald Eagle (Threatened, Proposed for De-listing)

Although no known bald eagle roost or nest sites exist in the watershed, the forest may have provided more suitable habitat prior to 1950. Timber harvest, plant succession and fire suppression has reduced the abundance, distribution and quality of

potential bald eagle nesting/roosting habitat on the landscape since 1950. Overstory removal, partial removal and regeneration timber harvest treatments in LOS ponderosa pine have removed preferred nest/roost trees. Fire suppression has resulted in increased stand densities, which has contributed to the mortality of the large overstory trees. Such trees are preferred by bald eagles for nesting and roosting. The current trend of large tree mortality due to high stand densities and insects and disease must be reversed if potential nesting/roosting habitat is to be maintained through time. In addition, plant succession is causing a change from true pine to mixed conifer in many stands. Mixed conifer stands are less suitable for bald eagle nesting/roosting. Prey habitat suitability has been marginal within the watershed during both historic and current time periods.

Foraging habitat quality has declined along the Sycan River where open, parklike LOS pine stands have been replaced by dense, multi-story LOS stands. Habitat quality has declined since the 1940's with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use.

Potential eagle nesting and roosting habitat (portions of P15, Sycan Marsh, Southeast) characterized by Isaacs and Silovsky (1991) in the Upper Sycan River subshed is not currently being managed for bald eagles, even though an active nest is located on private land adjacent to this area.

2. American Peregrine Falcon (R-6 Regional Forester's Sensitive Species List; recently De-listed from Endangered)

American peregrine falcon establishment is dependent upon prey availability of marsh-related species and terrestrial small mammals and birds. Marsh birds are most abundant during the wet cycles that occur about three of every ten years in southeastern Oregon. During drought years, waterfowl and shorebird numbers are low and any nesting peregrines would have to rely more heavily on small mammals and birds. Small mammal populations are cyclic with explosions and crashes. They currently appear to be rebuilding after a crash in population.

Wildfires maintained the upland prey habitat for peregrines prior to 1945. Fire suppression in recent years has allowed sagebrush to dominate sites and alter small mammal and bird habitat. Some open hunting areas have probably been lost due to fire suppression, making prey detection by peregrines difficult especially when small mammal populations are at low levels.

Habitat for prey species and foraging has improved where the removal of late and old seral (LOS) forest has increased the area of open, early seral forest cover types. Foraging habitat quantity and quality has declined where open, parklike LOS pine stands have been replaced by dense, multi-story LOS stands. Habitat quality has declined since the 1940's with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use.

Timber harvest has opened the forest canopy and gradually increased foraging habitat suitability in all forested subsheds. However, in the future, habitat for prey species and hunting would diminish if early and mid-structural stands progress in succession to an eventual overstory condition. Large created forage areas available for this species are not likely to occur in the future under predicted land management policies.

The possibility does exist that large forage areas will be created by wildfire. If current trends continue, large fires that remove forest overstory are likely to be more common in the decades ahead as the amount of acres in a dense vegetal state, with a high risk of stand-replacement fire, increases. Reductions in road densities could reduce disturbances and increase habitat security within potential habitat.

3. California Bighorn Sheep (R-6 Regional Forester's Sensitive Species List)

Potential California bighorn sheep habitat has been altered by livestock grazing and fire suppression. Early livestock grazing included domestic sheep use that impacted bighorns directly by competing for forage and space, and indirectly through the introduction of disease and parasites. Grazing by domestic sheep is no longer practiced; however, competition for forage may still exist between cattle and bighorns. Bighorn sheep use steep, rugged terrain inaccessible to cattle for foraging and lambing. However, competition for forage and space can occur where potentially suitable foraging habitat exists near suitable escape terrain.

Fire suppression has resulted in climax shrub communities with limited grass/forb production. Historically, wildfires maintained the bunchgrass communities important to foraging bighorns. Livestock grazing and fire suppression have changed the native perennial bunchgrass to native and non-native annual grasses, which may not be preferred by California bighorn sheep.

Quality and quantity of suitable habitat has declined with advanced succession of shrub communities and conifer encroachment.

4. Greater Sandhill Crane (R-6 Regional Forester's Sensitive Species List)

Sandhill crane habitat has been altered by livestock grazing, the reduction of the beaver population and to a lesser extent by fire suppression. Cattle grazing since the turn of the century may have affected sandhill crane nesting by decreasing concealment and increasing susceptibility of cranes and nests to predation. Quality and quantity of suitable habitat has also declined with sagebrush and/or conifer encroachment into meadow systems. The effects of early grazing and the reduction of beaver populations in riparian areas has resulted in the downcut stream channels, lowered water tables and the loss of deciduous and herbaceous vegetation. Periodic flooding caused by beaver damming activities historically acted to provide preferred nesting habitat for sandhill cranes. Loss of herbaceous cover due to grazing has resulted in increased predation on sandhill cranes. Fire suppression has allowed encroachment of conifers into meadow and riparian systems further degrading potential sandhill habitat.

5. Western Sage Grouse (R-6 Regional Forester's Sensitive Species List)

Although limited within the Upper Sycan watershed, sage grouse habitat was maintained by wildfire prior to Euro-American settlement. The quality of sagebrush habitat has declined with advanced plant succession and conifer encroachment. Fire suppression and livestock grazing have been the primary factors contributing to reduced habitat. Fire suppression has allowed sagebrush to replace and dominate sites previously occupied by grasses and forbs. This change in plant composition and structure has not benefited sage grouse productivity. Livestock grazing has removed grasses and forbs (the fine fuels necessary to carry a fire) and accelerated succession to sagebrush dominance. The loss of the grass/forb component has reduced potential nesting and escape cover and eliminated or drastically reduced the forb component critical for rearing broods. These two factors in combination with weather have probably contributed to the general decline of the species throughout its historical range.

Keystone and Other Terrestrial Species

1. Big Game

Seasonal big game ranges and migration corridors on private and public lands have been altered considerably within the past 50 years. Agents of change, including commercial timber harvest, fire suppression, wildfire, plant succession, livestock grazing, transportation corridors for public and industrial access and recreational developments have cumulatively altered the landscape. Drought, insects, and disease in recent years continue to cause additional modifications to all seasonal ranges and migration corridors in all ownerships.

Prior to Euro-American settlement, big game ranges were partially maintained by natural wildfires that created a mosaic of successional stages from early to climax. This provided the vigorous supply of winter browse, cover and early green-up grasses and forbs that is necessary for reproduction and survival.

Fire suppression since 1910 has acted as a habitat change agent and created an unnatural condition that has benefited browse species such as antelope bitterbrush and curl-leaf mountain mahogany in the short-term. However, in the long term, this same protection from wildfire has created even-aged decadent stands of bitterbrush and mahogany with reduced reproduction and vigor. Fire suppression has also allowed western juniper to establish in areas where juniper was historically a minor component of the landscape. In the absence of natural wildfires, juniper has expanded at the expense of the understory

shrubs and native herbaceous species. Natural fire regimes maintained stands in a mosaic of plants of various age classes and allowed vigorous growth and seedling establishment.

Livestock grazing, drought cycles, and insect outbreaks have also negatively affected big game range. Intense livestock overgrazing in the early 1900s by domestic sheep, cattle and horses created severe competition with mule deer for early green-up grasses and forbs and winter browse. Drought cycles that occurred periodically further limited grass/forb production and browse seedling establishment. Insect infestations contributed to the decline of browse species by limiting flower and seed production and affecting the overall vigor of plants

There has been a loss of riparian deciduous vegetation (willows, aspen and shrubs) and lowering of water tables in riparian zones as a direct result of overgrazing through the early 1900s. This in combination with insect infestations and resultant timber salvage operations has altered the abundance and distribution of fawning, calving and rearing cover and forage. The gradual current recovery of riparian vegetation, which is occurring around many stream and spring areas under present livestock management, should benefit deer and elk habitat.

The amount of effective cover is currently at optimum levels in most areas within the forested portion of the watershed. Distribution of cover, however, is poor resulting in large areas where cover is limited, thus reducing effective habitat. Since cover/forage ratios were not available for the historic condition, the relationship between historic and current cover/forage conditions is not specific. It can be assumed that more frequent fires historically allowed more herbaceous forage habitat in ponderosa pine habitats. Fire suppression throughout the twentieth century has caused a transition in stand structure from more open to more dense understories. This has increased hiding cover and reduced forage in historically open habitats. During the same period, timber harvest activities have reduced cover in higher elevation lodgepole pine and mixed conifer habitats. This has resulted in highly fragmented, patchy areas of cover where large, relatively unbroken tracts of cover existed historically. While forage areas were created by timber harvest activities, a continued creation of openings by harvest has not occurred on a large scale since the late 1980s. Many man-created forage areas have since reforested and are transitioning to a state of cover. Generally, thinning prescriptions within these openings allow for short term retention of forage but act to retard the transition to cover. Eventually, canopy coverage begins to retard forage production and at the same time, tree density in the thinned stands is generally inadequate to provide cover. In this case, the value of the stand as mule deer or other big game habitat is minimized. Fire suppression has also precluded creation of short-term forage areas. If current trends continue, loss of forage would become even more pronounced in the next several decades as large-scale wildfires and insect outbreaks become the sole creators of forage habitat. Prescribed fire and understory thinnings are tools that can be used to restore foraging habitat on a more predictable schedule. However, restoration of forage generally corresponds to a reduction in hiding, thermal and sometimes fawning/calving habitat. Maintenance of effective mule deer habitat at optimum or even minimum levels can conflict with management of forested stands for optimum sustainability. At some point, if historic forest stand conditions are promoted on a wide enough landscape scale, ODF&W and Klamath Tribes management objectives for mule deer population numbers would be impacted.

Big game security has been reduced by increases in road densities in the past 50 years. Road prisms have reduced the amount of available habitat and vehicle traffic has displaced big game from areas adjacent to open roads. Roads have also increased vulnerability to harvest and poaching, further reducing big game security. Road closures and obliterations could increase habitat availability and security.

2. Beaver

Livestock grazing, fire suppression, trapping and plant succession have contributed to a decline in beaver habitat and numbers that probably began around the turn of the century. Fire suppression and plant succession have reduced the availability and abundance of some important deciduous forage species. Shade intolerant and fire-associated species, such as aspen and willow, have most likely declined in density and distribution as decadent stands are replaced by conifers.

Historic as well as more recent livestock grazing has reduced the availability and abundance of summer herbaceous and winter deciduous forage species, and altered channel conditions and flow regimes. In some stream systems, these changes have occurred to the extent that beaver habitat requirements for water and food may no longer be provided. Upland timber harvest and road construction have contributed to altered runoff and stream flow regimes to the detriment of beaver habitat.

Trapping harvest and transplant records indicate that direct removal of beavers has also affected populations and most likely distribution as well. It appears that trapping pressure was heavy from settlement time through around 1920, and again from 1950 to 1970. The trapping closure initiated in 1988 and in effect until 1998 has probably protected beaver populations to some extent. However, on-going damage trapping and removal of beaver colonies near culverts has negatively affected beaver populations during this period.

As beaver are lost from the system, wetland habitat is reduced, as is associated plant and animal diversity and productivity. In addition, water and sediment storage and transport are altered, and nutrient cycling and decomposition dynamics are changed.

Recent riparian recovery, in areas where the loss of willow and other deciduous riparian species was limiting population growth, has benefited beaver populations. Recovery in local areas has allowed beaver to occupy new sites and be more productive in areas where they have existed throughout history.

3. Other Terrestrial Species

In general, the quality and quantity of habitat in forest and shrub communities has increased for wildlife species favoring advanced succession and multi-canopy layers, while decreasing for species favoring open, parklike forested stands or diverse age structure with grass and forb understory in shrub communities

Shrub dependent terrestrial species have declined in distribution and numbers due to livestock grazing, fire suppression, and plant succession. The natural mosaic of shrublands in a variety of seral stages historically maintained by wildfire has been converted to shrub dominated sites with very little herbaceous understory. Grazing also has removed much of the fine herbaceous understory needed to carry a fire. Current livestock grazing management should allow some recovery of upland shrub habitats. Full recovery may require the introduction of fire.

Riparian-dependent species have also experienced declines in distribution and abundance. This is attributable to lowered water tables, fire suppression, conifer competition and the loss of riparian woody vegetation associated with livestock grazing. These species should benefit under current livestock management, however, where late season use allows cattle access to riparian areas and deciduous riparian vegetation, recovery will be impeded.

Management Indicator Species (MIS) Associated with Late and Old (LOS) Forest Cover

1. General

Based on historic and current estimates for old growth habitats, total acres and continuity of LOS forested stands are currently less than what occurred historically. Acres and patch size of interior LOS have declined as well. Current average LOS interior patch size is minimal, whereas historically patch size probably averaged in the hundreds or thousands of acres.

Available and suitable LOS forest and dead wood habitat has decreased since 1945 primarily as a result of timber harvest activities. Insect and disease outbreaks, blowdown events, firewood cutting, hazard tree removal, road construction, and fire suppression have also contributed to the loss of habitat. These disturbance agents have removed snags, down wood and large diameter live trees, reduced patch sizes and connectivity, and diminished the amount of high quality LOS interior habitat and overstory canopy cover. Increased gaps and fragmentation have in turn increased the amount of lower quality LOS ecotone habitat. Insects, disease and wildfires generally increase the amount of dead wood habitat over areas that have burned, but follow up salvage logging can remove most of the large dead wood from the area.

True ponderosa pine communities have experienced the greatest reduction in dead wood and LOS forest habitat. Past management practices of overstory and partial removals of pine, as well as fire suppression, have converted forest stands previously dominated by open large diameter pine to stands with dense understories of ponderosa pine regeneration or stands now characterized as mixed conifer with dense lodgepole pine and/or white fir understories. Large areas of LOS pine were removed by regeneration harvest treatments. As a result, habitat suitability has declined for species associated with open,

large diameter pine stands such as white-headed and Lewis woodpeckers, flammulated owl and goshawk. Overall abundance and distribution of these species have most likely declined from historic levels.

Succession of forest cover above 5,500 feet and on fir sites at lower elevations toward a mixed conifer composition appears to be providing more habitat for pileated woodpecker, marten and other associated species as these forest stands develop LOS structural conditions. Succession of early/mid-seral lodgepole pine to late seral pine has created additional habitat for LOS associated species such as black-backed woodpecker. However, timber harvest activities have reduced forest cover in higher elevation lodgepole pine and mixed conifer habitats, resulting in highly fragmented patchy areas of forest cover in areas where large, relatively unbroken tracts existed historically.

The loss and fragmentation of available dead wood and LOS forest habitat since 1945 has reduced habitat availability and suitability. Smaller, scattered LOS patches amid large areas of forest habitat where large overstory trees are uncommon or early/mid-seral forest habitat dominates may no longer meet the habitat needs of some LOS associated species. Such a condition applies to marten and pileated woodpecker, which require large areas of contiguous LOS to meet home range habitat requirements. Isolation and crowding of individuals and pairs into these scattered patches threatens the stability of some species. Sink populations in marginal habitat patches cannot maintain themselves without continuous recruitment from source populations in preferred habitat conditions. Even the currently improved stands for species associated with LOS mixed conifer and lodgepole pine, such as the marten, pileated and black-backed woodpeckers, are offset by the fragmented nature of LOS patches and loss of interior habitat conditions.

Habitat security has gradually declined since 1945 as disturbances associated with a greatly increased road density and extensive timber harvest activities escalated through at least 1990. However, road closures/obliterations and lower levels of timber harvest activities in the future should reduce disturbances to LOS forest habitat and associated species.

Prescribed underburns and thinning could help restore more open park like stands of LOS pine habitat for associated wildlife species. Without treatment, existing stands of LOS forest and dead wood habitat are at risk to potential insect and disease outbreaks and catastrophic wildfire. The risk to higher, wetter and cooler true mixed conifer sites would be lower than the risk to lower elevation true pine and warm site mixed conifer stands. The risk for the occurrence of these events has increased in the last 50 years.

Under an assumed forest management scenario on private lands similar to present management, LOS forest and dead wood habitat that has been or is eliminated and replaced by early/mid-seral forest will not return to the landscape. Forest habitat that matures on private lands in the future likely will be harvested before it develops LOS forest characteristics. As such, it will remain marginal sink habitat for MIS and other species associated with LOS forest and dead wood habitats. On National Forest lands, LOS forest and dead wood habitat should gradually increase in abundance, continuity, distribution and quality over the long term if forest management objectives that focus on development and maintenance of LOS continue and as tree plantations grow into mature forests. Edge contrast between existing LOS forest and early/mid-seral forest will slowly diminish as tree plantations mature over time and are managed more for forest structural diversity.

It is unlikely that the watershed will ever again provide LOS forest habitat within the range of historic variability. Also, the intermingled ownership pattern will continue to contribute to the gaps and fragmentation of LOS forest habitat that exists presently. It is also highly unlikely that LOS open, park like, single story ponderosa pine forest habitat will ever be as abundant and contiguous as it was prior to 1945. However, the acres of LOS mixed conifer forest are expected to increase over time. Overall, the future abundance and distribution of wildlife species associated with LOS forest habitat, especially ponderosa pine, will be less than occurred historically.

2. Northern Goshawk

Goshawk habitat quantity and quality has declined where open, parklike LOS pine stands have been replaced by dense, multi-story LOS stands. Increases in lodgepole pine LOS appear to have influenced goshawk territory locations. Nine of 11 territories within the watershed are located partially or totally within lodgepole pine habitats. This may reflect a loss of suitable habitat in ponderosa pine and mixed conifer habitats rather than a preference for lodgepole pine. Goshawk appear to be utilizing the dense overstory, high canopy coverage, LOS lodgepole pine stands for nesting activities. Insect infestations in lodgepole pine and resultant salvage activities as well as general timber harvest activities are rapidly reducing the

availability of this habitat for nesting goshawks. Habitat security has declined since the 1940's in association with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use.

Foraging habitat quantity and quality has declined where open, parklike LOS pine stands have been replaced by dense, multi-story LOS stands. Habitat for goshawk prey species and foraging has improved where the removal of late and old seral (LOS) forest has increased the area of open, early seral forest cover types in small (< 4 acres) patches and edge habitat around larger openings. Habitat quality has declined since the 1940's with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use. Potential forest regeneration treatments on private lands and smaller openings created by future uneven-aged treatments on National Forest lands could continue to create edge habitat for goshawk prey species and more suitable prey and hunting habitat for goshawks. Road closures and obliterations would help reduce habitat fragmentation.

3. Pileated Woodpecker

Habitat availability and continuity have declined during the last 50 years. However, habitat suitability may have increased in patches of LOS forest habitat where open, parklike LOS pine stands have been replaced by dense, multi-story LOS stands or mixed conifer has replaced or invaded pine stands. Such changes provide the dense conditions, increased overstory mortality and down wood that characterize suitable pileated woodpecker habitat. The improved stand conditions that presently exist in LOS mixed conifer are offset by the fragmented nature of LOS patches and loss of interior habitat conditions. Sanitation and salvage harvest prescriptions continue to reduce dead wood habitats, reducing the suitability of these habitats for pileated woodpeckers. Habitat security has declined since the 1940's in association with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use.

4. American Marten

Habitat availability and continuity have declined during the last 50 years. Habitat suitability however, may have increased in patches of LOS forest habitat where open, parklike LOS pine stands have been replaced by dense, multi-story LOS stands, and where mixed conifer has replaced or invaded pine stands, or where increases have occurred in LOS lodgepole pine habitats. Such changes provide the dense conditions, increased overstory mortality and down wood that characterize suitable marten habitat. Sanitation and salvage logging, however, have limited the availability and abundance of this habitat. Additionally, the improved stand conditions that presently exist in LOS mixed conifer and lodgepole pine are offset by the fragmented nature of LOS patches and loss of interior habitat conditions. Habitat security has declined since the 1940's in association with increased disturbance from higher road densities, increased commercial logging activity, and greater recreational use.

As plantations grow into the mid-seral condition class, habitat conditions for marten prey species will decline. Lower marten populations could result in higher rodent populations, which will damage or kill tree seedlings. Smaller openings created by future uneven-aged treatments could create more suitable prey and hunting habitat for marten.

5. Black-backed/Three-toed Woodpecker

Habitat availability and suitability have declined in ponderosa pine and mixed conifer habitats. This decline can be attributed to the loss of LOS pine forest and to forest succession in remaining LOS forest from ponderosa pine to a more mixed conifer forest. Black-backs prefer true pine types and large contiguous stands rather than fragmented patches of LOS forest cover interspersed with early to mid seral disturbance patches. Maximum and mean patch size and interior habitat in LOS ponderosa pine and mixed conifer habitat have declined since 1945. Habitat availability and suitability have increased in lodgepole pine habitats with the increase in LOS forest cover. Overstory mortality occurring in large diameter pine and fir in recent years from drought, overstocked stands, and an increase in disease and insect activity in all stand types have created additional snag habitat. This has improved nesting habitat conditions and foraging opportunity. Sanitation and salvage logging, however, have limited the availability and abundance of this habitat.

Dead Wood Habitat Management Indicator Species (MIS)

1. Primary Excavators

Loss of dead wood and subsequently smaller populations of cavity excavators, with more restricted distribution, means less predation on insect populations. Strong populations of woodpeckers can actually help suppress epidemic outbreaks of insects that cause extensive forest mortality.

All subsheds have probably experienced a decline in primary excavator populations in the last 50 years, although localized shifts in distribution to reflect blowdown, fire or insect outbreak events have undoubtedly occurred. Habitat quantity and continuity have declined during this period while suitability has increased with large tree mortality in late and old forest cover.

Trends in the vegetal character of the landscape lead to conclusions for several species. Excavators associated with open late/old ponderosa pine forest cover, such as white-headed and Lewis woodpeckers, have undoubtedly experienced a decline in habitat suitability/availability and bird distribution and abundance. This decline is a result of forest succession from an open pine to a denser understory and/or mixed conifer dominated forest with a large component of lodgepole pine or white fir. Stand succession and fire suppression have also increased stand density to the detriment of these species, which prefer more open understory stand structure.

Sanitation and salvage harvest prescriptions and underburning will continue to reduce dead wood habitats, but if sufficient snags and down wood are protected and additional amounts of down wood are created through insects, disease and fire, most dead wood associated MIS and other species should maintain stable populations.

Aspen/Deciduous Riparian Habitat MIS

1. Red-naped Sapsucker

Aspen is gradually being replaced by conifers, primarily as a result of plant succession and fire suppression. Several factors have contributed to a decrease in aspen regeneration, including: the decadent condition of mature aspen, the change in forest structure to dense conifer stands, encroachment of conifers into meadow areas, rangelands and riparian stringers, and the buildup of debris on the forest floor. The regeneration that does occur is often set back by livestock grazing and big game browsing pressure. Where stream channels have been downcut and/or widened and the water table lowered, the site potential for aspen may have been significantly reduced or lost.

Habitat quantity, continuity and suitability has declined since the turn of the century primarily due to grazing, increases in browsing ungulate populations, fir suppression and lowered water tables. This loss of preferred habitat for sapsuckers, several neotropical migrant bird species, beaver and other deciduous riparian vegetation dependent species is a contributing factor limiting population numbers and distribution of these species across the landscape. Both population levels and distribution of aspen and deciduous riparian associated species has declined in the Upper Sycan Watershed. To help maintain population levels, management actions that minimize the effects of grazing, along with the reintroduction of fire and management of encroaching conifers must be implemented in order to halt the gradual loss of aspen and restore its presence to areas where it historically occurred.

IV. Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

Timber

Timber harvesting conducted both on private lands and on the National Forest, particularly harvest of large ponderosa pine, following the end of World War II has left a visible impact on the forest landscape through out much of the watershed. Besides the removal of large trees, road building and other logging related ground disturbances are apparent.

Up until World War II, timber harvest had been limited, with most of the timber going to local markets. The style of cutting focused on removal of scattered large trees and tended to leave a natural appearing forest when harvest was completed. After World War II, the increased demand for wood products triggered an accelerated harvest scenario that slowly began to change the appearance of the natural landscape.

Harvest levels on the National Forest lands held steady or increased, peaking in the 1980's. In the 1990's, management guidelines directed the planning and implementation of timber sales toward an objective of maintenance and enhancement of LOS. This has triggered a shift in the type of harvest from overstory removal or regeneration or uneven aged management, to understory thinnings (both precommercial and commercial). Timber harvesting in the past 10 years has reached a relatively stable rate, well below the levels of recent decades. Timber management activities are currently focused on large tree culturing. Smaller diameter trees than were harvested in past decades are being cut. Most harvests occur on gentle slopes. Outputs are expected to remain steady for the next several years.

Grazing

During the latter part of the nineteenth century, homesteaders who had settled at the lower elevations of the watershed would move their cattle, sheep and horses seasonally up into the higher reaches of the drainage basin. During the early part of the twentieth century, sheep and cattle grazed heavily throughout the watershed. It wasn't just their vast numbers, but the fact that they grazed year around that had an effect on the watershed's vegetation. After the Taylor Grazing Act of 1934 and World War II, domestic grazing declined. Gradually sheed herding gave way to cattle production and today cattle are the dominant commercial grazing animal in the watershed.

Impacts from earlier grazing activity can still be seen today, especially in the condition of some of the streambanks and riparian areas at the lower elevations. Also, plant species composition has been altered to some extent by intensive grazing. Grazing, however, does not seem to have had an impact upon the presence of those food plants that are traditionally of interest to the American Indian people.

Range management in this area has changed significantly over the past 30 to 40 years. Reduced animal numbers and pasture rotations have led to an overall improvement in range conditions and riparian habitat. Partnership agreements with permittees have benefited both the permittee and the resources. Improvements continue to occur, utilizing grazing as the disturbance agent in some plant communities.

Recreation

The increased demand for recreation on the National Forests has affected this area. More and improved campgrounds, trail construction, universal accessibility, and improved roadways have been provided in response to the demand for increased recreation. Recreation is currently one of the Forest Service's primary emphasis items. This trend is expected to continue, and as such, will affect future activities in the Upper Sycan Watershed.

Subsistence Hunting

The Klamath Tribes traditionally, and currently, use the area for subsistence hunting of mule deer. Tribal reliance on mule deer increased along with increases in the mule deer herd during the 1950's and 60's. Some of these increases in herd size can be tied to improved mule deer habitat as a result of wildfire suppression. Any significant increase in the use of prescribed fire, especially when combined with understory thinning, has the potential to impact both cover and forage components of mule deer habitat. The Tribal Game Commission has consistently expressed concern about the effect that the reintroduction of fire could have on mule deer habitat.

STEP 6. RECOMMENDATIONS

Step 6 provides recommendations based on the analysis presented in the previous 5 steps. This step also identifies monitoring activities that are needed in association with these recommendations. Data gaps and limitations of the analysis are also documented. Recommendations are designed to identify management activities that are responsive to needs identified in this watershed scale analysis. Specifically, management actions which address differences between current and reference conditions, where there is a need to provide restoration, maintenance, or protection of ecosystem components in order to sustain the health and productivity of natural resources. Any actions or projects, which utilize the information presented in this Watershed Analysis, will be analyzed on a site-specific basis by an interdisciplinary team and will include both public involvement and disclosure of decision as prescribed by the National Environmental Policy Act (NEPA).

I. Watershed and Aquatics

Uplands

Key Question 1): Is the upland portion of the watershed/subwatershed producing hydrological conditions (water and sediment outputs) that contribute to properly functioning riparian areas?

1. Upland Plant Communities and their Effect on the Amount of Water and Sediment Reaching Riparian Areas

To reduce the risk of catastrophic fire and associated soil erosion, sedimentation, and increased flows, especially in the ponderosa pine and mixed conifer sites, forest understories should be thinned. Refer to the map *Figure 5.1 - Upper Sycan River Watershed Upland Vegetation*, following page (5-1), for locations of areas with canopy closures, which exceed historical conditions. This will promote conditions for low intensity fires to re-occur, either naturally or controlled, throughout the watershed and reduce the potential for epidemic insect and disease outbreaks.

In the dry meadows, aspen stands, and other non-forested areas, conifers (including juniper) that became established after the advent of fire suppression should also be considered for thinning. Aspen stands will continue to decline across the subwatershed with the absence of fire. Thus, the use of prescribed fire, as well as thinning of conifers, is recommended to restore these sites (when thinning conifers within these stands, fall the trees in an array that provides a barrier to livestock grazing--this enhances the likelihood for sprout reproduction to regenerate).

Where junipers have encroached, thinning may be required to promote the growth of native grasses, forbs, and shrubs. In these areas, trees should be selectively cut. Limbs should be scattered on the ground to prevent erosion and provide a better environment for the growth of ground vegetation. Removal of boles would be acceptable under some conditions. Although juniper encroachment has been slow, and primarily isolated to the western portion of the watershed, curtailment is necessary so junipers do not eventually dominate a larger portion of the western watershed--leading to even more adverse effects on water quality.

Where possible, skid trails and landings should be eliminated throughout the watershed to alleviate past soil impacts, beginning with those areas where understory treatments will occur.

Recommendations to enhance and manage watershed conditions for the desirable hydrologic regime (snowmelt hydrograph) coincide with maintaining favorable conditions for northern goshawk. For example, desired conditions for uplands, described in Chapter 4, state that openings (early-seral condition) can account for approximately 5-20% of the forest lands within subwatershed/watershed--based on research which has shown detectable changes in stream flow when 20-30% of a watershed is in a cutover condition (Troendle 1982). This corresponds with management recommendation for northern goshawk, which call for maintaining about 35-50% of the forested stands in a late-seral condition (mature and old), roughly

35-50% being in a mid-seral condition (young and mid-aged), and the remaining 5-20% in openings and early-seral condition (Reynolds et al. 1991). Furthermore, these recommendations state that openings/early-seral condition areas be less than 4 acres in size. Again, these recommendations correspond with those for maintaining a desirable hydrological regime. When the objective is to reduce the highest flows and spread runoff over a longer period of time, small openings (2-8 tree heights across) on low energy slopes, tend to deposit snow in concentrations where melt is delayed (Satterlund and Adams 1992). This may be considered desirable since it is believed that the effects of the increased drainage network throughout the Upper Sycan River Watershed, from roads and detrimental soil compaction, have modified or desynchronized the flow regime (modified the timing, magnitude, and frequency of peak flows).

2. Road Density, Location, and Drainage Network

To reduce the adverse effects of roads on aquatic resources, road miles should be progressively decreased through obliteration or permanent closure. In the Upper Sycan River Watershed, to reach the desired road density of 1.7 mi/mi² and a functioning appropriately rating will require obliterating approximately 122 miles of road. At the subwatershed scale, meeting these same desired conditions, would mean obliterating roughly 35, 25, and 62 miles of road in the Paradise Creek, Long Creek, and Sycan River subwatersheds, respectively.

During the summer of 1999, an inventory of all roads within the analysis area was completed to determine which roads were necessary for recreation, access, and a sustainable flow of goods and services, as well as to identify those unneeded or substandard roads for decommissioning. From this information numerous roads were identified as unneeded or causing environmental damage. These are shown in Figure 6.1 – Roads Recommended for Obliteration or Permanent Closure in the Upper Sycan River Watershed. The following table, Table 6.1 – Road Density, Location and Drainage Network in the Upper Sycan River Watershed, shows a comparison of current road density, location, and drainage network information with the same parameters if these recommendations were implemented.

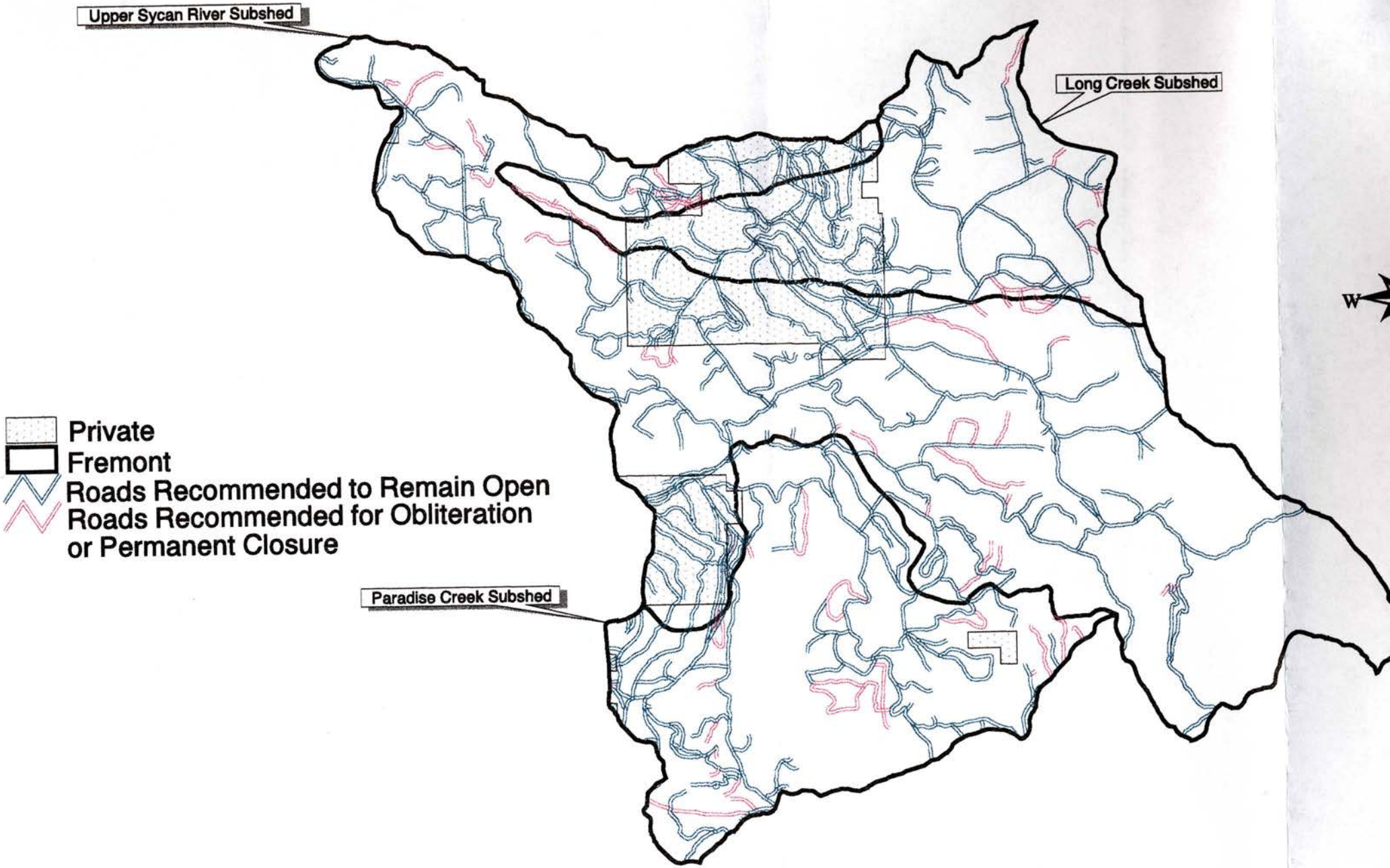
Table 6.1 - Road Density, Location and Drainage Network in the Upper Sycan River Watershed.

Subwatershed/ Watershed	Road Density (mi/mi²)	Road Miles	# of Crossings / Crossings per Mile of Stream^	Road Impact Index (RII)	Road Miles within 300 feet of Streams*	Road Density (mi/mi²) within 300 feet of Streams*	Increase In Drainage Network (%)
Current Conditions							
Paradise Creek	3.1	77	33 / 0.8	0.35	6.5	1.7	105
Long Creek	3.1	55	17 / 0.7	0.18	6.8	3.0	138
Sycan River	2.7	164	69 / 0.7	0.64	21.0	2.1	96
Upper Sycan River Watershed	2.9	296	119 / 0.7	0.49wa	34.3	2.2	104
If Recommendations Are Implemented							
Paradise Creek	2.5	63	23 / 0.5	0.20	4.6	1.2	86
Long Creek	3.0	52	17 / 0.7	0.17	6.6	2.9	130
Sycan River	2.5	150	61 / 0.6	0.51	15.6	1.6	88
Upper Sycan River Watershed	2.6	265	101 / 0.6	0.38wa	26.8	1.7	94

^ includes perennial, intermittent and ephemeral channels
* perennial and intermittent stream only
wa – weighted average of the three subwatersheds

Emphasis for obliteration should be placed on those roads within 300' of streams or which have numerous stream crossings. The remaining roads should be properly drained to reduce the hydrological connection to stream channels, resulting in less water and sediment flowing down roads and their ditches. This promotes better infiltration of water into forest soils to be slowly released into stream channels.

Fig. 6.1 Roads Recommended for Obliteration or Permanent Closure in the Upper Sycan Watershed



Riparian Vegetation and Stream Channels

Key Question 2): Is vegetation in riparian areas contributing to appropriate channel types and hydrologic regime?

1. Riparian Vegetation and Associated Bank Stability

In all reaches where conifer encroachment is common, mechanically thin encroaching conifers and/or allow prescribed fire to creep into riparian areas. This will reduce conifer densities and maintain growth of riparian grasses, shrubs, and trees. Implement grazing management that promotes the growth of willow and improves width-to-depth ratios along C and E stream types. Continue deferred rotation grazing strategies, or other types of grazing strategies that maintain or promote late-seral riparian plant communities and their associated high bank stability. Also, the implementation of INFISH – Aquatic Conservation Strategy – guidelines will guide timber harvest operations so they will not adversely affect riparian vegetation.

In reaches 1-5 of the Sycan River, the topography of the river canyon functions as the allotment boundary separating two allotments, however, no fences exist along the river. It is recommended that either fences or large trees be placed in the gaps where livestock are able gain access into the river canyon. This will keep livestock from finding their way down into the river corridor, where they can spend a good part of the grazing season. It would also prevent the mixing of cattle from the two separate allotments. Furthermore, it may be necessary to develop water sources away from Skull Creek (or implement other grazing strategy changes) to improve livestock distribution and restrict the amount of trailing and bank trampling along riparian areas of Skull Creek.

In areas of high bank instability, found mainly in reaches 6 and 7 of Paradise Creek, Reaches 4 and 6 of Watson Creek and Reach 1 of the Sycan River, place sedge mats or root wads as described by Rosgen (1996). Also, treat all headcuts within the watershed, such as the one at the headwaters of the Sycan River, to prevent a lowering of the water table and a loss of riparian vegetation.

Management which promotes late-seral vegetation will improve habitat conditions for beaver. Reintroduction of beaver should occur once sufficient vegetation exists to support beaver populations.

2. Rosgen Stream Type(s)

Implement recommendations in the upland and riparian vegetation sections described in this chapter. Emphasis should be placed on implementing grazing practices that promote the growth of sedge, rush, and willow – plants required for high bank stability and low width-to-depth ratios in low gradient systems. If structures are utilized along the eroding meanders, they should only be placed when meander geometry (lateral erosion) is fully developed or when there is a risk of losing sinuosity. These actions will aid in maintaining or producing the desired stream types.

Habitat for Aquatic Species

Key Question 3): Are the channels providing adequate fish habitat?

1. Large Woody Debris (LWD)

In the short-term, add LWD in those reaches of the watershed where numbers are below the functioning appropriately category. Emphasis should be placed on the following stream reaches: Reach 2 of Paradise Creek, Reach 2 of Watson Creek, and Reaches 1-4 of the Sycan River. Additional large wood in the channel will enhance sediment retention, especially in the event of a catastrophic fire, and help improve water quality and aquatic habitat. Long-term solutions to LWD recruitment can be achieved by leaving buffers along forest reaches (buffer widths are prescribed in the INFISH Aquatic Conservation Strategy).

2. Pools

Even though ***total*** pool numbers are at desired levels in all but one of the stream reaches surveyed, additional ***large*** pools are needed – in many of these reaches – to meet desired conditions. Although the small size of most of these streams may be limiting the amount of large pools, the abundance of late seral vegetation is promoting continued recovery. This recovery will improve channel integrity and lower width-to-depth ratios, conditions that promote deep and complex pools that have an abundance of undercut banks for fish cover. To accomplish this, grazing strategies that promote the growth of late-seral vegetation will need to be maintained or promoted. Also, managing for beaver and their dams would increase deep pool habitat and cool water refugia (Reach 1 of Watson Creek serves as an example of how beaver dams can influence the number of large pools).

In those reaches where LWD additions are recommended, which occur mainly in B stream types, the added pieces of LWD will help create additional pool habitat. Large wood will also make pools more complex, increasing cover, depth, rearing habitat, cool water refugia, and over-wintering habitat. For LWD to effectively create a pool, the added pieces must be within the bankfull dimensions – preferably within the wetted channel. Consult with a hydrologist and fishery biologist when implementing these habitat improvement projects.

3. Spawning Gravel Fines

In planning for access and travel management, where appropriate, obliterate roads within 300' of streams and/or those that have numerous stream crossings. The remaining roads should be properly drained to help reduce the amount of sediment reaching streams. Based on the Road Impact Index numbers listed in this chapter, the Paradise Creek and Upper Sycan River subwatersheds should receive priority when considering road obliteration projects. Maintain, or improve, the existing riparian vegetation and associated bank stability by implementing recommendations in the riparian vegetation and Rosgen stream type sections. Restore LWD to desired levels where needed for additional bank stability and sediment storage. Manage for increased beaver colonies throughout the watershed to enhance sediment storage.

4. Stream Temperature

Higher stream temperatures can be found in the mid to lower portions of Paradise Creek, Watson Creek, and the Sycan River all of which are located within, or downstream of, low gradient meadow or forest/meadow reaches. These are the areas that require the most attention within the watershed, because they have been affected by at least one factor influencing stream temperatures – stream channels that are slightly wider than desired, loss of riparian and upland shade, lower stream flows caused by increased evapotranspiration, etc. With continued improvement in riparian and stream channel conditions, shading and a narrowing of stream channels could result in slightly lower stream temperatures, however it is unknown as to whether or not current state standards can be achieved in all streams.

Implement recommendations found in the riparian vegetation and Rosgen stream type sections of this chapter. These recommendations will promote late-seral vegetation that results in narrow stream channels and decreased surface areas exposed to solar radiation.

5. Fish Passage (Culvert)

Replace those existing culverts identified as barriers with ones that allow for fish passage (Refer to Figure 5.2 - Upper Sycan Watershed Road Locations). Ensure that culverts are properly sized and installed at the appropriate location and slope by working with a hydrologist and engineer. Survey the remaining stream crossings within the watershed to determine if any other barriers exist (not all road crossings occur on fish-bearing streams).

Key Question 4): How are the above subwatershed conditions influencing native trout viability?

By implementing the recommendations listed above, each of the assessment elements will move closer to, or meet, its desired conditions, all of which will bring native trout viability towards the functioning appropriately category. In doing so, desirable watershed attributes should occur across the landscape, those that provide for high water quality, an abundance of high-quality fish and wildlife habitat, and high forage production.

DATA GAPS AND MONITORING ACTIVITIES:

- Because the Upper Sycan Watershed has been identified as a recovery unit for bull trout, stream surveys are needed to document habitat conditions in the following streams: Rifle Creek, Rock Creek, Boulder Creek, South Fork Sycan River, and Long Creek.
- Inventory the remainder of the steam crossings to determine if any other barriers exist.
- Further stream temperature information within the watershed is needed, with emphasis on those areas that provide potential habitat for bull trout.
- Data is needed on the level of soil impacts that have occurred within the watershed.
- Implement monitoring strategies described in the "Formal Consultation and Conference on Grazing and Associated Activities Affecting Listed Suckers and Bull Trout within the Four Watersheds on the Fremont National Forest" and/or those described in the new R1/R4/R6 Grazing Implementation Module.
- Implement Best Management Practices (BMP's) described in the "Formal Consultation on Road Construction and Maintenance Activities Affects Listed Suckers and Bull Trout within the Four Basins on the Fremont National Forest" (this document covers road decommissioning, erosion control, culvert installation, road maintenance, etc.)

II. Vegetation

Key Questions:

1. How have landscape patterns of plant communities and seral stages changed over time?

2. What caused the changes in the landscape patterns of plant communities and seral stages? What effect have the changes had on the watershed's ability to withstand catastrophic events?

3. What rare or designated sensitive plants occur in the watershed?

4. Why and to what extent are noxious weeds invading sites within the watershed, and what strategies can be used to slow or prevent the spread of noxious weeds?

Forested Uplands

GENERAL

1. In the Ponderosa Pine and Pine Associated types emphasize return of at least 35% of the stands to a single-story LOS condition. In doing so, retain the entire existing LOS component. Locate treated stands to surround existing old growth as

much as possible to increase the percentage of core old growth. Thin mid seral ponderosa pine to favor the development and protection of large diameter ponderosa pine.

2. Some existing Forest Plan designated old growth stands are currently isolated without good connectivity corridors to other stands. Where this is the case designate corridors averaging four hundred feet in width and encourage prescriptions that result in development of future LOS as rapidly as possible, i.e. tend fewer healthy pines than full occupancy of the sites might warrant if the goal were maximization of fiber production. Establish connectivity corridors and manage to connect the existing designated old growth stands. Proposed corridors have been mapped and entered into GIS Arc coverage with input by ecology, silviculture, and wildlife specialists on the analysis team. Prescriptions in identified connectivity corridors should be consistent with criteria in LRMP Amendment #2. Connectivity corridors should be stands in which medium diameter trees or larger are common, and canopy closures are within the top one third of site potential.

3. Where white fir climax stands occur leave all LOS components. Unless evidence of severe overcrowding is overwhelming these stands will most likely survive as is for long periods and adequate large tree replacements will enter the stands from the understory.

4. There is little silvicultural or ecological reason to enter lodgepole stands at this time. Resources to conduct density reductions will be better used in the ponderosa pine types than in lodgepole. In lodgepole pine stands where mountain pine beetle attack is imminent, do not attempt to apply vegetative prescriptions designed to "beetle-proof" these stands. Experience has shown that such attempts have little likelihood for "success". Rather, allow the mortality to occur and then initiate appropriate salvage activity, with full consideration given to: a.) recovery of commercial value, b.) maintaining desired levels of old growth/over mature dependent species habitat, c.) managing fuel loadings at an acceptable level of risk.

5. Utilize understory thinning in areas that are above historic density levels. This includes primarily ponderosa pine and mixed conifer stands - see the map *Fig. 5.1 Upland Vegetation in the Upper Sycan Watershed*, following page (5-1).

6. Where conifers have become established in aspen stands an opportunity exists to fall the conifers in arrays of barriers to grazing that will most likely allow sprout reproduction to regenerate. Remove competing conifers from aspen stands. If regeneration is required, stimulate aspen clones to regenerate with prescribed fire or mechanical means. Protect young aspen by providing slash barriers, pasture management, or exclusion fencing as a last resort. Remove or reduce conifers from areas of encroachment, including dry meadows and riparian areas

7. Identify declining black cottonwood clones. The highest elevation on record of a cottonwood clone on the Forest exists on Long Creek. Analyze the need to improve the hydrologic integrity to support cottonwood restoration. Establish new areas of cottonwood utilizing material from the nearest existing clone, following guidelines in the *Fremont Native Species Guide*

8. An adaptive management approach should also be used in the few stands containing white bark pine, adjacent to the Hanan Roadless Area

9. Focus on an adaptive management approach when manipulating LOS mixed conifer stands on low energy aspects, and high elevation LOS lodgepole. Focus management efforts on those eco-tones where ponderosa pine is already present to some degree. These fringe pine sites often require some culturing efforts to facilitate the development of ponderosa pine.

PRESCRIPTIVE

Management Zones. Relevant to any silviculture prescription is consideration of calculated "Classic" upper (UMZ) and lower (LMZ) management zones for that plant association (Table 6.2a). These stocking guides were developed to approximate a "safe" region of stand density where stocking related mortality processes are minimized. Classic stocking guides are used as target management objectives to maximize stand growth and as a benchmark to compare alternatives. Use of this data cannot be expected to eliminate all insect and disease problems. Impacts of diseases (except dwarf mistletoe), and of insects (except mountain pine beetle and perhaps western pine beetle), may be independent of density. Stands with mixed species should be managed by using the guides for single species prescribing the fewest number of trees per acre

(ponderosa pine)(P.H. Cochran 1994). This data has been further tempered to reflect stocking capacity for local pant associations (Hopkins 1979) and enables the Southern Oregon/Northeastern California (SORNEC) variant of the Forest Vegetation Simulator Model to approximate stand growth (Dixon 1992). Due to variations in local site index and other resource objectives, alternative management zones can be developed and implemented. Monitoring is an essential task when managing stands outside the "Classic" management zones. Table 6.2b. illustrates the outcomes of the classic stocking regime compared with two alternatives with elevated management zones.

Table 6.2a.
Management Zones by Forested Plant Associations
Within the Upper Sycan Watershed
Expressed as Stand Density Index (SDI)

Plant Association (Hopkins)	Acres	SDImax	SI	UMZ	LMZ
Ponderosa Pine					
CP-S1-21	4,210	284	76	114	76
CP-H3-11	4,353	284	78	119	80
CP-C2-11	938	284	76	114	76
CP-S2-11	4,522	284	77	116	78
CP-S2-17	3,466	284	77	116	78
	17,489				
Mixed Conifer					
CW-S3-13	1,653	332	80	146	98
CW-S1-17	1,558	310	80	146	98
CW-C3-11	2,819	410	77	168	113
	6,030				
Lodgepole Pine					
CL-G3-15	11,741	326	73	170	114
CL-G4-15	7,616	263	66	170	114
CL-C1-11	88	263	51	170	114
CL-H1-11	573	428	79	170	114
CL-S2-15	27	263	67	170	114
	20,045				

Where:
Stand Density Index (SDI)= The number of trees per acre when the quadratic mean diameter of the stand is 10 inches DBH.
Site Index (SI) = Mean values determined by Hopkins for Pant Associations of the Fremont National Forest. Site index is based on average height of dominants at age 100 years. Values for mixed conifer are for ponderosa pine. (Hopkins 1979)
SDImax= Stand Density Index values of maximum (normal) stocking as determined by SORNEC (Dixon 1992).
UMZponderosa= SDImax [-0.36 + 0.01(SI)] (P.H. Cochran 1994)
LMZ = .67(UMZ) (P.H. Cochran 1994)

Table 6.2b.
Comparison of three stocking regimes[1]

Parameters	CLASSIC	ELEVATED	EXTREME
Management Zones	LMZ= 27%SDI_{MAX} UMZ= 41% SDI_{MAX}	LMZ= 35%SDI_{MAX} UMZ= 55% SDI_{MAX}	LMZ= 50%SDI_{MAX} UMZ= 75% SDI_{MAX}
Decades as LOS[2]	12	11	11
Average % Crown Cover During LOS[3]	19	24	32
Volume Harvested MBF/Ac (# entries)	13 (4)	13 (3)	9 (2)
Average SDI	104	131	182
Average Basal Area ft^2/acre	82	102	140
Years with 3+ snags per acre > 11"	30	60	110

[1]Data calculated with the Forest Vegetation Simulator (FVS) modeling a "bare ground" projection (210 years) of a ponderosa pine plant community with an SDI_{max} of 284 and a site index of 68.
[2]LOS conditions assumed when the stand mean diameter reaches 18 inches DBH.
[3]Percent crown cover calculated with the FVS Canopy Extension Model.

As the next section will describe, activities within stands of various conditions of these three basic stocking regimes would be implemented at various places across the watershed. The Silviculturist with the Interdisciplinary Team would identify site-specific issues and recommend an array of stocking guidelines to address those issues. Site-specific stand conditions would help guide the preferred course of prescription. Such issues are:

- Site Index or carrying capacity. The lower the site, the riskier elevated and extreme stocking levels become.
- Plant association or ecotones of plant associations within a larger plant association. A single cutting unit may have several stocking regimes within them.
- Structural requirements of the stand to provide habitat for any one or a variety of featured wildlife species. Elevated stocking regimes provide more snags through time.
- Current stand health. Presence of annosus root disease within a mixed conifer plant association may dictate a classic stocking regime requirement.
- Early through mid-mid seral conditions will generally be prescribed to classic stocking guidelines. Elevated stocking would occur with the later seral stages.

Early Seral Stage Stands

All Plant Associations

These stands are products of regeneration management activities, which required artificial or natural regeneration practices that established the current stocking levels. The watershed contains approximately 6,500 acres of these stands. About half of these areas are lodgepole pine seed tree systems. The seed tree systems (leaving 5 to 10 large seed producing trees per acre) will produce thousands of seedlings per acre. Plantations consist of mostly ponderosa pine from seedling to sapling size trees, planted at 10 to 12 foot spacing. Various levels of residual trees were left within these units. Lodgepole pine and white fir residuals are a common component within most plantations. Tree ages range from 3 to 25 years. Stocking varies, but most sites are carrying in excess of 250 to 500 trees per acre. Most plantations less than five years old have yet to be certified and are receiving periodic stocking exams and animal damage control treatments (vexar, BGR, gopher baiting).

Manage these stands so they will continue to develop into mid seral stage structures. Favor the ponderosa to maintain growth and vigor to grow into the later seral stages and reduce risk of mortality from bark beetles. At that point more options can be considered. Seed tree areas were designed for removal of the seed trees once the seedlings were established. If the seed trees need to be retained for their values as "large trees", do so with caution if infected with dwarf mistletoe (DMT). Many seed trees within the Taylor and Elementary sale areas are infected with DMT.

Prescription
Schedule precommercial thinning when trees begin to differentiate and close crown. At average stocking levels and site, this will occur when the plantation is 15 to 25 years old. Thin as early as practical so to minimize fuels and maintain at least a 30% Live Crown Ratio (LCR) on the leave trees. Prescribe an average spacing that will get the stand to a nine-inch mean DBH near the UMZ. For most ponderosa pine plantations this works out to about 18 to 20 foot spacing (120 trees per acre), for lodgepole pine spacing is 13 to 18 feet (200 trees per acre). Select leave trees with at least a 25% variance in target spacing so the best trees are left while allowing some diversity in spacing. In most cases select against white fir and lodgepole pine. Favor any sugar pine and incense cedar (to some extent). Where any one species are considered uncommon (<5% of stocking) a certain level of these trees should be retained. Where fir is present in discrete clumps, consider leaving those clumps unthinned to retain a scattering or mosaic of cover and structural diversity. If any dwarf mistletoe is present on residual trees within the stand, consider removing those sources (fell or girdle). Consider the amount of infection, species and condition of the tree, and risk of infection to the plantation.

Address proposed thinning actions with NEPA when the watershed is next analyzed for a commercial sale. Prioritize based on degree of differentiation and stocking level. Prioritize fire dependent plant associations first (ponderosa pine, ponderosa pine associated mixed conifer). Treat stands of lesser priority when it is not practical to leave them for the next entry. Coordinate any necessary fuels treatment. Due to the relatively dense, even size of these young stands, thinning with fire should not be considered accept in RARE cases.

As of 1999, most of the late-early seral lodgepole has been thinned. These are the regeneration areas in the Green Mountain, Crazy Creek, Cold Springs areas. Ponderosa pine and white-bark pine were the uncommon species and were favored. Rapid in-growth is a concern any time lodgepole stands are opened up. Take added measures to monitor these stands after thinning. Monitor the growth and vigor of the higher canopy as the understory reinitiates.

Mid Seral Stage Stands

Ponderosa Pine Plant Associations
The watershed contains about 8,400 acres of mid seral ponderosa pine stands. The previously mentioned early seral plantations will begin to trickle into this category of stand stage structure. A full spectrum of these stands occur, from early-mid, dense post and pole stands, to late-mid stands that are beginning to take on LOS characteristics. The presence of ladder fuels is a concern in many stands. Many of these stands are exhibiting the symptoms of various forest health problems such as mountain pine beetle, and heavy mistletoe infection, while others are healthy having been precommercial thinned and receiving one or two prescribed underburns. Almost all these stands were created in response to understory reinitiation from fire prevention and various degrees of removal of the reference period pine overstory. Many of these stands are also occurring as trees encroach onto meadows, aspen stands, and riparian areas.

While few of these areas occur within Goshawk PFA, most do occur within foraging territory.

As with the early seral stands, management should focus on predictable development of these stands to grow into healthy LOS structures. For these fire dependent ecosystems, maintenance of the high canopy and controlling understory reinitiation are the two fundamental management concerns. The mid seral stage is where the high canopy becomes defined. Historically, frequent fires burned and thinned trees, defining the spatial distribution of the trees that make up the canopy. This distribution tended to be clumpy with patches of younger cohorts scattered about. Active management can help "set the stage" for mid seral structure to grow into LOS. Opening up the canopy will trigger understory reinitiation, so a reintroduction of prescribed underburning should be emphasized. Without management, these stands become susceptible to mortality agents before they become LOS or will become high risk in the early-late stages. Generally, this is not what happened historically.

Prescription
A general prescription is a low thin, and stocking reduction to the LMZ. LMZ can be adjusted if a specific reentry period is desired. Prioritize those stands that have the widest departure from the UMZ. Prioritize treating stands adjacent to LOS stands so they will blend together and create larger blocks of LOS. Stand should be relatively free of bark beetle infestations. It is critical to select stands to thin that will provide leave trees that will respond to thinning. Leave tree ponderosa need to

possess at least a 30% LCR. Presence of dwarf mistletoe is not as important as healthy full crowns. Calculate average leave tree spacing for diameter classes using the target LMZ. A target basal area can also be calculated if desired. Consider removing conifer encroachments where they occur. Determine from other specialists, what level of meadow restoration should be done, release of aspen stands, etc....

Thin to leave the largest, healthiest ponderosa pine available. Leave tree marking is usually most desirable so crew can concentrate on what is being left. Follow current Forest Plan, as amended, by NOT removing any trees greater than 21 inches DBH. This should not be a concern within mid seral structures. In fact, stands with a scattering of these trees will turn out to be the most desirable trees to leave. Select against juniper and white fir.

Consider marking so as to leave a clumpy pattern across the stand. Be stand specific as to what extent "clumpiness" can be projected when marking leave trees. Many stands initially exhibit a pattern of clumps, and this pattern is usually reflected but softened after thinning. Some stands are very uniform and "clumpiness" would need to be prescribed as defined leave islands or variable spacing techniques. Avoid thinning clumps of more mature trees that share a common root system (usually reflected in crown form). In Goshawk territories, clumps exhibit some degree of intertwined crowns, which are important structural attributes.

Some level of fuel reduction and stand cleaning may be required after the thinning harvest. Alternatives could include, no further treatment, prescribed fires to kill the smaller trees, or mechanical felling of remaining understory followed by leaving, mechanical crushing, spot piling slash, or prescribed burning (or some combination). Tending most mid seral structures should lead to an eventual regime of prescribed underburns so as to maintain and develop LOS character in these fire dependent ecosystems.

Mixed Conifer Plant Associations

The watershed contains approximately 1,400 acres of mid seral mixed conifer stands. These stands tend to be the results of overstory removals where the large ponderosa overstory was removed from even-aged advanced regeneration of white fir, ponderosa pine, and in some cases lodgepole pine. Many of these stands were precommercial thinned for the fast growing white fir to get to a target size when a clear-cut harvest would have then been prescribed. Meandering, ponderosa plantations were created within many of these stands when the overstory removal and mistletoe cleaning would leave portions understocked. The two main objectives of such management were to conserve scarce high elevation ponderosa pine seed and to capture future volume growing on the fir.

Due to their inherent higher densities, many of these areas are within Goshawk PFAs,

The drought of the early 1990's triggered extensive mortality across the Fremont N.F. Many of the fir stands suffered mortality or top kill from fir engraver beetle. Annosus root disease pockets were becoming evident. These pure fir stands, predisposed by drought, have little or no resilience to these mortality agents.

Manage these stands so that a stable species distribution becomes established. Favor any existing pine species while replacing a portion of the white fir with ponderosa pine. Develop an uneven-aged system to favor shade intolerant species. Few stands will benefit from culturing the fir component. Stocking is usually adequate for fir, and the bole damage created by a thinning operation would usually not be suitable. Key in on getting more species established.

Prescription

Employ the group selection system of uneven-aged management. Select stands where the white fir is exhibiting symptoms of forest health problems. Identify areas within the stand of fir that have engraver damage, root rot pockets or old mechanical damages. Designate small groups of ¼ to 4 acres and remove all the fir. Remove fir from around any ponderosa in the stand. Allow at least two crown radii around selected pine to culture. The size of these patches and the percent of stand treated will vary. A good average may be to keep patches between one to three acres, treating 15 percent of the stand. Openings less than one acre may not provide the growing space that pines require. Consult with the Hydrologist and Wildlife Biologist regarding guidelines on opening size, percent of stand opened, and juxtaposition of patches.

Follow harvest by preparing the site for planting. Fell undesirable trees within patches. Treat fuels as needed, but retain as much down wood and debris as practical. Plant ponderosa pine seedlings at a spacing to match the site potential and the animal damage hazards. Some sugar pine and incense cedar may be mixed into the planting. Microsite seedlings where

practical. Be prepared to control big game browse and gopher damage. Schedule precommercial thinning as usual.

The use of prescribed fire as a tool must be closely scrutinized. A site-specific evaluation would need to occur in order to meet objectives.

Continue monitoring stands for mortality of the fir. Implement patch cutting and planting as practical to address stand health. Where older plantations are present in the stand, link their thinning or cleaning to a total stand entry.

Late or Old Seral Structure (LOS) Stands

Ponderosa Pine Plant Associations

Late and old ponderosa pine occurs across approximately 2,000 acres of the Upper Sycan River Watershed. The one main criterion that makes these stands LOS is that large trees (>21"DBH) are considered common across the site. Common can mean as few as five or six large trees per acre. Other attributes connected with LOS function (i.e.- snags, large woody debris, canopy layers, etc.) vary within stands and between stands. The presence of certain attributes may make a stand function as LOS with only a few large trees per acre present (Hopkins 1993). These stands vary in amounts of management activity that has occurred in them. Most stands have had some overstory removed in them. Many stands have had prescribed underburning occur. Most stands have had their LOS structures degraded

Under current management direction, LOS structures are to be maintained and protected. Management should cause "No Net Loss of LOS" (Eastside Forest Plan Amendment 1994). The management of aggregations of stands that form larger blocks of LOS is critical. This philosophy implies mimicking historical landscapes.

Objectives for management are similar to those of the mid seral pine stands. For these fire dependent structures to persist, maintenance of the high canopy and controlling understory reinitiation is critical. For many stands, fire has been used to check fuels build-up. This tool should continue to be used to check unwanted understory conifers. Understory competition is the most immediate hazard to LOS stands. Dense understories tax the site's growing potential as well as cause the stand replacement fires detrimental to the whole watershed. For stands with few and scattered large trees, management should try to maintain those trees and focus on development of the mid and early components of that stand.

Many stands can begin restoration with prescribed underburning alone. When prioritizing stands for restoration treatment through cutting, careful calculation of stand density and overstory condition is essential. Calculate SDI as an accumulation of the SDI of each diameter class. Assess the condition of the overstory canopy. This can be very subjective. What is the age of this layer? How much of this layer exhibits 5, 10, or 20 year mortality risk? How many trees greater than 21 inches exist, and how are they distributed across the stand?

Prescribe LOS restoration when:

- Dominant and codominants are ponderosa pine >18 inches DBH, > eight per acre with more soon to grow into that class.
- UMZ is exceeded due in large part to a lower and middle strata.
- High canopy is relatively healthy and not actively declining.
- For a timber sale, be able to harvest at least 1500 board feet per acre at conventional ground based systems costs. The more expensive the logging, the more volume per acre will be required to support it.
- Stands are adjacent to blocks of functional "old growth" and an opportunity exists to enlarge that block through treatment.

Stands with highly decadent overstories should be low priorities to restore. With the intent of direction as "no net loss of LOS", priorities should focus on stands that will respond to density control. These decadent stands will serve other resource functions while in decline.

Prescription

This prescription can be implemented across multiple, adjacent, stands of the same type. Remove all stems from within two crown radii (or some other estimate of effective growing space) of ponderosa pine greater than 21" DBH. Remove additional trees in order to thin from below portions of the stand beyond the effective growing space limit. Spacing within the low thin can be calculated from the target LMZ.

Post sale fuel reduction and stand cleaning should be evaluated similar to treating the mid seral stand. Caution should be exercised here due to a broader range of diameter classes that may be required to manage in this type of stand structure. Size class distribution will dictate when and how much fire can be reintroduced into the stand.

Mixed Conifer Plant Associations

Late and old mixed conifer occurs on approximately 3,200 acres within the Upper Sycan watershed. White fir is much more abundant in these stands, and is often present in the overstory. These stands compose some of the best PFA habitat in the watershed. On low energy slopes (north and east aspects) above 6000 feet elevation, white fir may occupy 90% of the overstory canopy and have dense fir layered below. Evidence shows long fire return intervals. These are difficult stands to diagnose due to subtle shifts in ecotones and disturbance processes. On the higher energy slopes (south and west aspects) and below 6000 feet elevation, most stands have or show evidence of having supported various levels of ponderosa pine overstory, maintained by a frequent fire regime

It is the LOS occupying the high-energy slopes where management can benefit restoring and maintaining viable LOS structure, and should considered high priority for silvicultural treatment. These stands have departed historic patterns as radically as on ponderosa pine sites.

The low energy stands pose several complexities. Where elsewhere we think of white fir as an unwanted invader, here it is a historic and persistent component. LOS on these sites is rich in diversity across multiple dimensions (species, seral stage, etc.). Dynamic disturbance processes at a small scale maintained such diversity. Today's stands are losing this diversity in seral stage distribution but at a much slower rate compared to the fire dependant stands. Any management geared to balance diversity must be done by subtle means. Past efforts at managing white fir with shelterwood systems have failed. Mimicking historical disturbance on these sites will require an adaptive management approach to prescribing treatments. For the immediate future, management activities within low energy stands should be low priority on any large scale.

Prescription on High Energy Sites

Employ very similar methods as described for ponderosa pine LOS. On some sites, white fir will be required to manage in the stand. Ecotones which transition from low to high energy sites within the same stand are common. Recognizing and prescribing for these conditions is very subjective. Evaluating the presence of fir in the overstory and the vigor of the fir understory will provide clues as to what extent white fir should be managed. Consider not culturing of the pure fir thickets if they are not affecting growth of ponderosa. When annosus root disease is not observed within a stand where white fir is to be managed, consider applying borax to all fresh fir stumps greater than 15 inches diameter (outside bark). When treating stands that have root rot centers, borax will probably not be effective. Focus on displacing fir for pine species on these sites. Improvements to PFA habitat would be realized by opening up some of these understories.

Prescribed underburning may be an excellent option when the objective is to turn white fir out of a high-energy LOS stand. Small white fir is easily killed with fire. Staged burns with several entries over several decades will be required to restore most stands to their reference conditions. Mechanical pretreatment will be required on many sites. An adaptive management philosophy needs to be employed to find the most beneficial balance when selecting tools to implement restoration.

Prescription on Low Energy Sites

Most stands in this category should receive the diagnosis of NO TREATMENT. Management activities should be left on the scale of a "custodial" theme. Most of these stands are being dependent upon to provide closed canopy, dense LOS and old growth habitat for Goshawk as well as many other "closed forest" species. These stands account for less than 10% of total mixed conifer LOS. They tend to occur on steeper slopes. Structurally, they are within their historic range of variability.

Small group or single tree selection would approach mimicking natural disturbance. Some degree of coarser fragmentation would also be appropriate. Require borax applications in annosus free stands.

Prescribed underburns should not be attempted within these stands, without assuming great risk of replacing that stand.

Lodgepole Pine Plant Associations

The watershed contains approximately 16,000 acres of lodgepole pine LOS structure. These stands are centered west of Winter Ridge, surrounding the Paradise drainage, and at the highest elevations in proximity to Taylor, Shake and Black Buttes. These stands evolved under extremely variable fire return intervals. To date, research has concentrated on the "pumice", and Rocky Mountain lodgepole. Very little research addresses conditions found on portions of the Fremont N.F. Our evidence shows that high elevation lodgepole on the Fremont exhibits departure from the typical lodgepole "even-aged/beetle/burn, every century" standard. On average, these high elevation stands tend to be hard to burn and tend to resist massive bark beetle outbreaks at predicted densities, BUT these processes are always present. Though not spectacular (on average), they have driven how these stands look today in very subtle ways. These stands tend to be low in wood fiber productivity but do offer unique wildlife habitat and are located in sensitive headwater regions. White-bark pine is an uncommon species found in these stands. Populations of blue-leaved penstemon have been found in these stands. Fire exclusion has caused only subtle changes to these stands. The early and mid seral structures, which were historically scattered throughout, is slowly disappearing. Stands are becoming more crowded which may be excluding both white-bark and penstemon.

Management should take a cautious, adaptive management approach when addressing the LOS lodgepole in this watershed. Prescriptions need to be site specific and take into account site potential, affected species, and the role of fire. These are marginally productive sites so management needs to be linked to other resource needs.

Prescription

Creating small gaps by group selection could mimic much of how fire and insects interact in this forest type. Prescribed fire to prepare site for natural regeneration would be the most natural method to follow-up harvest activities. Prescribed fire would be conducted cautiously on a site-specific basis. Fuel loading, burn windows, and seasonal access make logistics of prescribed fire in these forest communities extremely difficult. An alternative of mechanical site preparation has been successfully implemented in many other lodgepole types on the District. More advanced regeneration could be managed if areas were site prepped mechanically. Many factors would be involved with deciding what percent of the stand would be treated. The degree of current stand clumpiness would give an indication of what magnitude of fragmentation would be appropriate.

White-bark pine occupies a very interesting ecological niche that is not well understood. Any prescription should emphasize culturing white-bark pine. A combination of release and thinning should increase vigor to this species. Many times, white-bark will grow as a clump (a lost seed cache?). A representation of these clumps should be retained.

Western Juniper and Hardwoods

Western Juniper

It has been clearly demonstrated that western juniper is an invader on most forested sites were it currently grows. Encroaching populations should be discriminated against while older "refugia" populations can be retained. Use of prescribed burning is an important tool for maintenance of stands where there is potential for juniper invasion. Mechanical means may be the only option to remove juniper from a site, followed by subsequent burning. See hydrology report.

Aspen Management

Quaking aspen can be found growing throughout the Upper Sycan Watershed. It grows in small, scattered populations, associated with springs, streams, or perched water tables. Aspen also grows with a complex of ponderosa pine in several relatively large areas. One such area is west and northwest of Government Harvey Pass. Aspen's main method of regeneration is asexual. When the parent clone is distressed (fire for instance), it sends a signal throughout its root system to begin sprouting root suckers. Throughout most of the stands lifecycle, it is a fireproofed island surrounded by lands courting frequent fires. As the aspen mature and fuels accumulate, fire will sweep through again to trigger regeneration. Aspen tend to be relatively short-lived as an individual tree, but the clone can persist for centuries through asexual reproduction.

Being highly associated with fire to regenerate the species, aspen stands are generally in decline due to fire exclusion and conifer encroachment. Browse from cattle and big game will also keep regeneration from becoming established. Once the parent clone is dead, that patch of aspen is lost. Management should seek to allow aspen stands to proliferate within the

means of its ecologic processes and resource constraints. Prioritize treating clones of lowest vigor.

Prescription
Prescriptions need to be developed with an Interdisciplinary Team of specialists. The objectives of the treatment need to be clear and precise. Is regeneration desired? Is the release of this stand all that is required at this time? Aspen often inhabit riparian communities were it is critical to receive additional direction from the Hydrologist as to harvesting material from these areas. Many aspen patches can be treated while treating the larger conifer stand.

The key to most aspen prescriptions is the release of the site for aspen to grow. Remove all conifers from within a specified distance of aspen. An example may be to remove conifers from within six crown radii of any aspen tree.

The most efficient method to propagate aspen is with coppice vegetative reproduction. This involves using a saw (or perhaps fire) to cut off some of the stems, which stimulates vertical growth on newly produced shoots. If regeneration of the aspen is desired, a certain degree of disturbance will be required to initiate root suckers. Protection of aspen sprouts to browsing needs to be addressed. **Options need to be weighed and contingency planning addressed.** If logging disturbance fails to initiate suckers, would felling aspen do the trick? Would there be follow-up deep ripping if felling failed? If logging slash fails to restrict browsing, is more slash created or exclusion fencing required? A moderate to hot burn has been shown to promote excellent aspen sprouting. Should burning be utilized on the site and if so what about browse protection if the slash is consumed? How does management of the adjacent upland stand fit with managing the aspen?

Black Cottonwood
A genetic base of current cottonwood populations (clones) has been identified within the watershed. In general, cottonwood is in decline. Several high elevation stands have been identified and their ecologic niche is not well understood. Since cottonwood health is dependant upon competing conifers, animal browse, and water relations, silvicultural and hydrological issues need to be addressed when planning to restore these stands.

Prescription
Clones that are in decline should have cuttings collected to establish a stool bed before the clone is lost. Cuttings can then be planted on or near the original site, depending upon stream conditions. In areas where black cottonwood is vigorous with adequate regeneration, management should focus on protection of that clone's aquatic environment and conifer competition.

KNOWN DATA GAPS:

- Current stand exam information including snags, down wood, disease centers and fire history,
- Stand exam data, interpreted, automated and linked to a spatial layer in ARC-INFO,
- Empirical data demonstrating the efficacy of restoring LOS forests by understory removal, stocking guidelines for late/old forests
- Accurate vegetation condition class layer in ARC-INFO,
- Logging plan including economic analysis of logging alternatives for watershed,

Non-Forested Uplands

1. Return natural openings and meadows that have been altered by tree invasion to approximate historic range of variability. Where conifers are encroaching on dry meadows (typically lodgepole pine), remove conifers to reverse this trend. Forested vegetation management recommendations modeled after Northern Goshawk habitat requirements that facilitate detection and capture of prey by goshawks favor the maintenance of open understory and small patch openings. Maintaining these systems will benefit hydrologic function and retain forage/habitat quality. Prescribed fire and thinning can be used to meet these objectives. Restore meadow and forest openings to near reference conditions with consideration to Goshawk PFA

requirements. However, these standards should not deter the manager from restoring a meadow or forest opening to historic conditions greater than 2 acres.

2. Implement prescribed burning in bluegrass dry meadows, hairgrass moist meadows and big sage bunchgrass communities in the watershed. Burning meadows and big sagebrush sites will reduce litter accumulations and decadent shrub cover, promote nutrient cycling, limit conifer encroachment and promote plant vigor.

3. Manage for fair to good range condition and static to upward trend on non-forested vegetation communities. Communities in fair to good range condition reflect proper range management. Plan for deferred rotation grazing where possible in all allotments in the watershed. Deferment reduces plant physiologic impacts particularly on bluegrass-dry meadow systems.

4. Monitor domestic ungulate browse and affects on aspen regeneration in the watershed. Current levels of aspen utilization by livestock are unknown.

KNOWN DATA GAPS:

- Specifics regarding browse on aspen
- Riparian classification and seral status

Fire

In Ponderosa Pine and Pine Associated types (excluding Lodgepole):

(see also Non-forested Uplands Recommendations #1 and #2, immediately above)

1. Use prescribed fire alone and mechanical methods in combination with prescribed fire to meet objectives of reducing density and altering structure of stands.

2. To the extent that fuel amounts, fuel arrangement and management objectives allow, conduct management ignited prescribed fire activities at frequencies and intensities similar to the natural fire regime appropriate to the site.

3. Fire prescriptions should be fairly conservative until vegetative mosaics, fuel loading and continuity have been modified enough that a more liberal fire prescription is possible.

4. Consider landscape level treatments to create a network of areas with reduced crown fire potential.

5. Remove ladder fuels and reduce stand density to a level at which a fire is unlikely to spread in the tree canopy.

6. Utilize prescribed fire and mechanical methods to protect Forest improvements (i.e. plantations, TSI areas, structures and cultural resources) from unacceptable fire effects.

In Lodgepole Pine and climax White Fir types:

1. Prescribed fire alone or in combination with mechanical methods should not be used for the purpose of maintaining stand structure.

Noxious Weeds

The noxious weeds in this watershed are still susceptible to eradication with vigorous effort and minimal use of herbicides. Insure that all sites are added to the current Fremont Weed Control Contract or are treated mechanically to contain their spread. The window of opportunity to arrest this incipient invasion will last, most likely, for only a few years. Use of

picloram formulations against the musk thistle and spotted knapweed and glyphosate against the Canada thistle is recommended.

Threatened, Endangered, or Sensitive Plants

1. Pending further information about the effects of fire on Green-Tinged paintbrush, avoid use of prescribed fire in mountain big sagebrush communities where Green-Tinged paintbrush occupied habitat occurs. Use guidelines in the Conservation Strategy for Green-tinged paintbrush where other activities are planned in managed populations of green-tinged paintbrush.

2. Use the provisions of the Conservation Strategy for blue-leaved penstemon where activities are planned in occupied habitat of blue-leaved penstemon.

III. Terrestrial Species and Habitats

Key Questions:

1. How have wildlife abundance, distribution, diversity and habitat conditions been altered?

2. What key terrestrial habitat components are scarcest or most at risk? What threatens species viability?

3. Where are the known problem areas that are contributing to reduced wildlife habitat capability?

Threatened, Endangered, and Sensitive Species

1. Northern Bald Eagle (Threatened, Proposed for De-listing)

Use prescribed burning, road management, and mechanical treatments including commercial and precommercial thinning to establish preferred nest/roost tree or stand characteristics and enhance prey base habitats to increase prey populations.

Consider adding the area identified for potential eagle nesting/roosting habitat (portions of P15, Sycan Marsh, Southeast) characterized in Isaacs and Silovsky (1991) to the existing Bald Eagle Management Area (BEMA, MA 2) adjacent to the western watershed boundary at T.32S., R.14E. Sections 27-33. Pursue the preparation of a Forest Plan Amendment to add these to the BEMA (MA 2). This includes areas within both the Upper Sycan Watershed and the Sycan River at Sycan Marsh Watershed, Log Spring and Chocktoot subsheds. It includes area currently allocated to Wild and Scenic River (MA 11) and Visuals (MA 6). Management within the BEMA would need to be consistent with the previously established allocations to MA 11 and MA 6. This appears possible, as MA 11 includes direction to maintain a largely undeveloped character, and permits activities that maintain or enhance the quality of wildlife habitat. MA 6 generally calls for managing to maintain or enhance natural appearance. Most or all potential habitat improvement activity within a BEMA is consistent with such objectives.

> Reason: The watershed may serve as a seasonal, opportunistic foraging area where foraging activities occur in response to localized increases in the prey base. Treatments would reduce the risk of loss of potential nest/roost trees and stands, enhance available habitat, and increase the available prey base, promoting additional eagle use and enhancing eagle survival and productivity.
>
> The area identified as P15, Sycan Marsh, Southeast in Isaacs and Silovsky (1991), not currently included in the existing BEMA, includes important foraging and potential alternate nesting habitat for bald eagles. Bald eagle habitat should be a major consideration in the management of this area.

2. American Peregrine Falcon (R-6 Regional Forester's Sensitive Species List; recently De-listed from Endangered)

Conduct periodic surveys for peregrine falcon activity at identified cliff sites especially if activities are proposed in the area. If peregrine nesting activity is identified, initiate a peregrine falcon management area plan to protect and enhance nesting, foraging and security habitats. Consider mechanical treatments, prescribed fire, road closures and activity restrictions to protect and enhance habitats.

Reason: Identified cliff sites have not been surveyed for peregrine activity. No nesting or roosting activities have been documented within the watershed. Management activities and public access could be impacting potential nesting opportunity at identified cliff sites. Mechanical treatments and prescribed fire would enhance peregrine foraging opportunities by increasing open hunting area and improving small mammal and ground nesting bird habitat.

3. California Bighorn Sheep (R-6 Regional Forester's Sensitive Species List)

Ensure that current livestock management in potential bighorn sheep habitat is designed to maintain an adequate forage base for bighorn sheep. Use prescribed burning and mechanical treatments to enhance bighorn habitat.

Reason: Prescribed burning and mechanical treatments will reduce conifer encroachment, set back shrub succession, and stimulate grass and herbaceous forage production. Livestock management to maintain an adequate forage base will minimize competition between cattle and bighorn sheep.

4. Greater Sandhill Crane (R-6 Regional Forester's Sensitive Species List)

Monitor sandhill crane activity to determine if nesting is continuing within the watershed. Monitor nest success to determine potential effects of management activities. Use prescribed burning and/or mechanical treatments to reduce conifer encroachment in meadow areas to enhance sandhill habitat.

Reason: It is unknown at this time if current management activities are affecting sandhill crane nesting opportunity. Conifer encroachment has diminished the suitability of meadow habitats for sandhill crane nesting.

5. Western Sage Grouse

Use prescribed burning and mechanical treatments to enhance sage grouse habitat. Design treatments to leave a mosaic of burned and unburned islands of sagebrush, establish a variety of sagebrush seral stages to meet the entire life cycle needs of sage grouse, and reduce conifer encroachment into sagebrush habitats.

Reason: Prescribed burning and mechanical treatments will improve potential sage grouse habitat by providing dense nesting cover, enhancing forb production, and reducing loss of sagebrush habitats to conifer encroachment.

Keystone and Other Terrestrial Species

1. Big Game

Manage forage, cover, and road densities on mule deer and elk ranges to provide habitat conditions necessary to meet Oregon Department of Fish and Wildlife (ODF&W) and Klamath Tribe herd objectives over the long term.

Design forest thinning treatments to provide a variety of spacing conditions, including no cut or minimal cut leave patches of dense structure. Treated stands should retain an interspersion of cover and forage where leave patches intended to provide thermal and/or hiding cover are 2 - 26 acres in size (Hershey 1997).

A reduction in hiding cover will occur for deer and elk with loss of shrubs, seedling/saplings and reductions in understories from prescribed burning and understory thinnings, prescriptions should be designed to minimize these effects. Treatments will provide early successional plant communities beneficial to foraging deer and elk.

Manage road densities on all seasonal big game ranges to meet the 2.5 miles/square mile, or less, standard in the Fremont LRMP. Managing toward a road density of 1.0 mile/square mile is preferred for minimizing disturbance to elk populations.

Maintain the quantity and quality of edge habitat. Use prescribed fire and selective thinning to maintain or enhance edge habitat. In existing small burns and regeneration harvest units (<80 acres), maintain 1 to 25 acre forage patches on sites near the edge of units. In more extensive burn areas, maintain 1 to 40 acre forage patches in a mosaic (Hershey 1997). Priority areas for treatment include those sites where shrubby forage species are decadent, forage productivity has declined because of an increase in forest cover, and/or preferred forage species occur. These openings will help maintain early seral foraging habitat for a longer period of time during forest stand development.

Reduce thinning slash and stem density where herbaceous and woody understory plant growth is limited. Emphasize hand piling or burning treatment where appropriate and limit mechanical treatments where soil objectives are a concern. Consider forage seeding of obliterated roads, skid trails, and landings to increase the forage base. Utilize guidelines established with the Fremont National Forest's Use of Native Plants policy for any seeding activities. Use prescribed fire and mechanical treatments to increase the quality, quantity, and species diversity of foraging habitat.

Monitor mule deer and elk habitat conditions within prescribed burn areas to determine the most appropriate fire return interval.

> Reason: A combination of treatments and protection of existing habitat features will provide forage and cover in a more favorable ratio, while reductions in road densities will increase security and make available more acres of useable habitat. The potential exists for declines in mule deer populations as habitat is treated with prescribed fire and/or mechanical understory treatments. These treatments will reduce cover, shrubby forage densities, and effective habitat, but will improve shrub age-class diversity, herbaceous forage, tree and plant vigor and productivity over the long term. Elk foraging habitat will increase with increases in grasses and herbaceous species. A corresponding increase in elk population numbers can be expected.

2. Beaver

Verify extent of active and historic beaver activity in the watershed on a project by project basis or through yearly monitoring activities. Document conditions of identified sites and determine the sites' ability to support beaver occupation.

Use prescribed burning and mechanical treatments to maintain and restore beaver habitat, deciduous and herbaceous forage species, and water availability near active and historic colony sites where these factors may be limiting re-colonization or productivity. Coordinate with hydrology, fisheries, and range programs to increase water levels in riparian areas where downcutting has occurred.

Implement a multi-year beaver transplant program in areas of potential and/or formerly occupied habitat where adequate herbaceous and deciduous forage exists for colony establishment. Multiple transplants over several years may be necessary for beaver to successfully restore habitat conditions to allow for yearlong occupancy.

Manage livestock stocking rates, season-of-use, and grazing schemes to maintain or restore deciduous and herbaceous forage species and water availability near active and historic colony sites and where the potential for beaver habitat exists within watershed and subshed drainages.

> Reason: Only minimal documentation of active, historic or potential beaver habitat exists for the Upper Sycan watershed. Restoration of beaver habitat and beaver populations will increase the area of wetland habitats and associated plant and animal diversity and productivity, improve water and sediment transport and storage, and stimulate nutrient cycling and decomposition.

3. Other Terrestrial Species

Use prescribed burning and mechanical treatments to enhance shrub-steppe, meadow, riparian and open forest habitats. Design treatments in shrub-steppe habitats to minimize loss of winter and security cover by leaving a mosaic of burned and unburned islands, to establish a variety of seral stages, and to reduce conifer encroachment. Design treatments in riparian habitats to stimulate deciduous and herbaceous species production and to reduce conifer encroachment. Design treatments in forested habitats to increase open forest habitat while providing for a diversity of healthy, forested habitats across the landscape.

Reason: Prescribed burning and mechanical treatments will enhance and increase habitat for wildlife species favoring shrub-steppe habitat with multiple age classes and a diverse grass/forb understory, riparian dependent species, and species favoring open forest habitats.

Management Indicator Species (MIS) Associated with Late and Old (LOS) Forest Cover

1. General

Manage for a matrix of late and old seral (LOS) forest habitat to move toward the natural range of historic variability at the subshed level. Manage forest habitat so that the forested landscape provides LOS habitat more closely representing the mix of single and multi-story LOS stands from reference conditions. Manage for increased patch size of interior LOS habitat. Manage for a diversity of structural stages and stand densities (basal area, trees per acre, and dbh) within and among stands to provide diverse habitat conditions for species richness.

Table. 6.3 - Recommended percent vegetative structural stage (VSS) and LOS management indicator species requirements.

Vegetative Structural Stage*	Recommended % for goshawk*	Acceptable Range	Species Requirements			
			Northern Goshawk	Pileated Woodpecker	Pine Marten	Black-backed Woodpecker
1** Grass, forb, shrub	10	5 – 20%	meets	N/A	meets	N/A
2 Seedling, sapling	10		meets	N/A	N/A	N/A
3 Young forest	20	35 – 50%	meets	N/A	N/A	N/A
4 Mid-aged forest	20		meets	partially meets	partially meets	partially meets
5 Mature forest	20	35 – 50%	meets	meets	meets	meets
6 Old forest	20		meets	meets	meets	meets

* (see Reynolds et al. 1992)
** openings no greater than 4 acres

Where practical, manage for an old growth restoration zone (600-1,200 feet) surrounding presently allocated and non-allocated old growth to buffer and increase forest interior habitat to a level nearer the range of historic variability. Determine the minimum required core area size. Design and implement prescriptions to develop and maintain late and old seral characteristics within the zone.

Manage all allocated and non-allocated old growth habitat, mapped in the 1994 completed inventory, and all late seral habitat, to conserve its character as interior and corridor habitat. Maintain and enhance connectivity "corridors" between all identified old growth habitats - see the map *Old Growth And Connectivity In Upper Sycan Watershed*, following page (3-15). Delineate, maintain, and enhance connectivity corridors between all LOS habitats when late seral habitat mapping is completed. Establish Riparian Habitat Conservation Areas (RHCA's) and manage forest stands within these areas to conserve LOS forest as a network of corridor habitat. Specific desired conditions for connective habitats are described in the "Forest Plan Amendment for Interim Standards" under "Interim Wildlife Standards" in the Fremont LRMP. Ground verify connectivity areas on a project by project basis, re-delineate and re-map as appropriate to utilize the best available connectivity habitat.

Manage for larger additional or replacement old growth stands within 1.5 miles of existing allocated and non-allocated old growth stands where the distance between these stands presently exceeds 1.5 miles. Select stands most resistant to natural disturbances over the long term, which have the most suitable habitat for the species of interest, and are distributed throughout the subsheds.

Implement non-uniform thinning and prescribed burn treatments where necessary to control understory stocking, reduce fuels, develop canopy gaps and multi-storied stands, restore open forest habitat where appropriate, and culture the development of large diameter live trees and future snags and down logs.

Design and implement forest management prescriptions featuring progressive or cluster treatments from existing scattered nuclei (particularly existing shelterwood, seed tree, overstory removal and partial cut units) to reduce risks to LOS forest cover associated with edges, gaps, fragmentation, and the amount of maintained roads. Cluster treatments are aggregations of similar treatments adjacent to areas already existing on the landscape to create larger, more homogeneous patches in order to reduce fragmentation. Progressive treatments occur where a central patch/patches or strip/strips is progressively enlarged by continuous similar treatment (Hershey 1997).

Maintain or restore the abundance and distribution of large diameter live LOS trees, large diameter snags, and large down logs in all forested stands. To accelerate the development of large diameter trees, mechanical and prescribed fire treatments should be implemented where appropriate to thin overstocked stands. Retention and recruitment of large trees should be a priority in stands dominated by younger age classes.

Maintain or restore open, parklike stands of LOS ponderosa pine with average tree diameters > 20" dbh (10-40 trees/acre) for white-headed and Lewis woodpeckers and pygmy nuthatch. A desirable condition would be trees > 24" dbh comprising > 40% of the total basal area at a density of > 8 trees/acre. Implement mechanical and prescribed burning treatments to: reduce stand densities, thin overstocked understories, reduce accumulated duff, culture patches of non-uniform multi-storied pine understories and large diameter trees, future snags and down logs.

> Reason: The goal is to develop a late and old seral forest network that protects and enhances the habitat effectiveness of the remaining LOS forest ecosystem by restoring historic characteristic landscape scale features to sustain associated management indicator wildlife species. Conservation of late and old seral forest habitat across the landscape rather than preservation of individual patches is the objective.

2. Northern Goshawk

Manage to protect active and historic nest stands and treat replacement nest stands, PFA's, and foraging areas to develop and/or restore preferred habitat conditions for goshawk nesting and rearing and to provide prey species habitat needs.

Maintain 30 acres of the most suitable nesting habitat surrounding all active and historic nest trees. Within a 1/2 mile radius of active or historic nest sites, maintain at least two 30 acre areas of the most suitable nesting habitat surrounding documented historic nest trees, and three 30 acre areas as potential replacement (alternate) nest sites. Defer active and historical nest areas from timber harvest. Replacement nest sites needing improvement should be treated by thinning from below with variable or non-uniform spacing using either mechanical means or prescribed fire to promote faster tree growth and crown development and reduce risk to insects, disease or fire. Replacement nest sites should be managed to provide for canopy closure >50%. Every documented nest site is considered "historically active" whether or not it has been monitored in

the last five years. Suitable habitat, as defined in the Fremont LRMP, must still be present at the nest site.

Designate a 400 acre "post fledging family area" (PFA) of the most suitable habitat around every known active nest site - see the map, *Goshawk Territories In Upper Sycan Watershed,* following page (3-31). Manage for a variety of structural stages as described in Table 6.3. Natural and permanently created openings, and created openings from fire and harvest activities greater than 2 acres do not count as part of the PFA. Manage to maintain and restore as possible the late and old seral structural characteristics of forest stands. Maintain a minimum canopy cover of 50% in ponderosa and lodgepole pine and 60% in mixed conifer stands. Create scattered openings of ¼ - 2 acres where necessary. Leave 3 to 6 large diameter reserve trees per acre in clumps in openings greater than 1 acre.

To increase the probability of successful fledgling production, maintain solitude in and immediately adjacent to active nest areas during the breeding, nesting, and fledgling period from March 1 through September 30, or during period of goshawk occupancy as determined from field observations by an experienced observer.

Manage a 5,400 acre area surrounding PFA's and nest stands for goshawk foraging habitat. Manage for a variety of structural stages as described in Table 6.3. Natural and permanently created openings, and created openings from fire and harvest activities greater than 4 acres do not count as part of the foraging area. Create scattered openings of ¼ - 4 acres where necessary. Leave 3 to 6 large diameter reserve trees per acre in clumps in the openings greater than 1 acre. Maintain a minimum canopy cover of 40% in ponderosa and lodgepole pine stands and 50% in mixed conifer stands or at the upper 1/3 of a site capability, where site potential cannot maintain the above percentages.

Utilize vegetative treatments that result in beneficial habitat for goshawk. This is characterized by 40% mature and old stands, 40% mid and young stands, 10 % seedling/sapling and 10% openings, in a well distributed manner throughout the watershed. Coordinate treatments that are designed to meet goshawk habitat needs with treatments designed to meet other objectives (i.e. improve sustainability, hydrologic function, stand diversity, etc.). In designing ¼ ac to 4-acre openings for goshawk there may be opportunities to meet other objectives. For example, in areas of "fringe" lodgepole stands, which contain ponderosa pine and white fir components, the creation of openings for goshawk habitat could take into consideration the advantage of decreasing competition (from lodgepole) on the uncommon ponderosa pine tree or group. Within Goshawk PFA and foraging areas exhibiting past overstory removals from pine and fir, replace patches of diseased and insect damaged white fir with planted ponderosa pine. Openings should be ¼ to four acres in size and leaving approximately three to six reserve trees per acre. Release and thin what older ponderosa pine exists in these stands. Within Goshawk PFA and foraging areas return multi-storied ponderosa pine and mixed conifer (pine associated) LOS stands to single-story LOS structures featuring large diameter ponderosa pine, by removing excess lower and middle tree layers. Prescribed fire should be utilized where it is possible to return the disturbance regime to a frequent fire return interval. Once stands are stable, use prescribed underburns on a periodic schedule to maintain structure. Retain younger ponderosa pine within classic bounds of upper and lower management limits.

In stands with overstocked understories and high fuel loadings, thin from below with variable or non-uniform spacing using mechanical treatments and/or prescribed fire to promote large tree growth, crown development, understory herb and shrub development, and open stand conditions for hunting and prey availability. Lop and scatter slash that cannot be burned. Leave 5-7 and 10-15 tons of woody debris per acre, greater than 3" diameter, in ponderosa pine/lodgepole pine and pine associated forest types, respectively, within territories (PFA's and foraging areas) to provide habitat for prey species.

See Reynolds et al. 1992 and Rodriguez et al. 1998 for complete description and clarification of recommendations.

Consider delaying salvage activities in beetle-killed lodgepole pine LOS at least 3-5 years or until dead trees begin to fall and stands begin to lose their value as goshawk habitat in known occupied goshawk habitats.

Reason: Numerous territories are documented and additional territories are suspected within the watershed. These territories represent the highest goshawk densities known on the Paisley and Silver Lake districts. Lodgepole pine habitats appear to be of high value to goshawks in the Upper Sycan watershed (9 of 11 territories with nest stands in lodgepole pine). Graham et al. (1999) revealed that goshawks will continue to nest successfully in beetle-killed forests and that as standing dead trees fall the habitat decreases in value. The U.S. Fish and Wildlife Service list the northern goshawk as a Species of Concern. Minimizing disturbance and maximizing habitat potential will aid in preventing further reductions in population numbers, as well as a trend toward federal listing.

3. Pileated Woodpecker

Determine/verify pileated woodpecker presence/absence in the watershed on a project by project basis, or through yearly monitoring activities. Manage for a higher basal area of large diameter white fir (>15" dbh) in true mixed conifer plant associations where occupied and historic pileated woodpecker foraging and nesting habitat occurs. Canopy closures in forest stands where foraging or occupation is evident should be managed at > 60%. Manage to maintain > 5 tree per acre that are > 20" dbh. Maintain or restore an abundance (>4/acre) of large diameter (>26" dbh) snags as potential nesting trees. Consider managing large down wood in occupied habitat at levels recommended in recent literature as compiled by ICBEMP (1997) (see Primary Excavators).

4. American Marten

Determine/verify marten presence/absence in the watershed on a project by project basis, or through yearly monitoring activities. Manage for a higher basal area of large diameter white fir (>15" dbh) in true mixed conifer plant associations where occupied or suspected marten habitat occurs. Canopy closures in forest stands where occupation is evident should be managed at > 40%. Manage to maintain > 6 tree per acre that are > 24" dbh. Maintain or restore an abundance (>3/acre) of large diameter (>24' dbh) snags as potential den sites. Consider managing large down wood in occupied habitat at levels recommended in recent literature as compiled by ICBEMP (1997) (see Primary Excavators).

5. Black-backed/Three-toed Woodpecker

Manage lodgepole pine LOS to buffer and increase forest interior habitat. Manage for an abundance of snags with bark intact. Consider delaying salvage activities in lodgepole pine LOS at least 3-5 years or until dead trees begin to lose their bark and stands begin to lose their value as black-backed foraging habitat. Consider managing snags in lodgepole pine habitats where black-backed woodpecker activity is evident at levels recommended in recent literature as compiled by ICBEMP (1997) (see Primary Excavators).

Dead Wood Habitat Management Indicator Species (MIS)

1. Primary Excavators

In all stands of ponderosa pine and pine associated forest, design future timber harvest treatments to maintain or restore snags and green replacement trees (GTRs) greater than or equal to 15" dbh at 100% maximum population potential (mpp) of primary cavity excavators. For lodgepole pine, maintain snags and GTRs greater than or equal to 10" dbh at 100% mpp of cavity excavators. Proper management application and specific desired condition for snags and down logs are described in the "Forest Plan Amendment for Interim Management Direction Establishing Wildlife Standards for Timber Sales" in the Fremont LRMP.

In addition, the desired condition for snag and GTR densities and distributions to achieve 100% mpp for cavity excavators was interpreted by the Fremont National Forest on 8/30/93 to be as follows:

> Fremont LRMP (as amended) standard for "...snag and green tree replacements of greater than or equal to 15" dbh at 100% potential population levels for primary cavity excavators".

DBH	Height	Trees/Acre
Pine/Pine Associated		
15"+ (20" preferred)	20'+	3 dead + 2 green
10"+ (12" preferred)	20'+	1 dead + 3 green
Lodgepole Pine		
12"+	15'+	1 dead + 1 green
10"+	15'+	1 dead + 1 green

Manage snags and green tree replacements in dispersed clumps rather than individual trees uniformly scattered over the landscape. As a minimum, manage for 1 clump/5 acres consisting of both dead and green replacement trees. This is based on the smallest home range size of primary excavator species in the current literature. Manage snags and GTRs in the same species composition as is represented in the stand. Manage for a large proportion (>50%) of standing snags > 33' in height. Retain spike- topped and lightning-scarred trees to provide alternate nesting substrates. Fremont LRMP (as amended) guidelines for snags are comparable to those of the most recent literature as compiled in ICBEMP (1995) recommendations except for lodgepole pine habitats. Six snags/acre >10" is recommended in lodgepole pine habitats.

In snag deficient areas, where feasible and appropriate, create snags from live trees. Implement top blasting, top girdling, and/or inoculant to create snags. Create bat slits/flanges, mimic lightning strikes, sap wells and cavities in created snags and existing hard snags to enhance snag habitat features and increase wildlife use.

Culture green tree replacements in early and mid-seral stands to develop future large diameter snags at the desired species composition and distribution for the full stand rotation.

Meet the following Fremont LRMP (as amended) standards as a minimum for large woody debris:

Minimum LWD Standards

Species	Pieces/Acre	Small end Diameter*	Piece Length	Total Lineal Length
Ponderosa pine	3 - 6	12"	>6'	20 - 40'
Mixed conifer	15 - 20	12"	>6'	100 - 140'
Lodgepole pine	15 - 20	8"	>8'	120 - 160'

* Leave 5 – 10 tons/acre of woody debris > 3" diameter in addition to the above and 8 – 10 tons/acre where the larger diameters noted above are not available.

Protect down logs and snags with fuel breaks and/or burn prescription where necessary to maintain the desired densities and size classes when implementing prescribed burn treatments. Develop burn prescriptions to ensure fire does not consume more than 1-1/2" per side of diameter of the featured down logs greater than 12" DBH in the above table. Lighting direction should specify avoidance of clumps of snags and down logs. Where case hardened logs result from burn treatments or wildfire, mechanically cut slits in logs or cut logs in half to improve habitat for wildlife use. This is especially critical in pileated woodpecker foraging areas, goshawk PFAs, and riparian areas.

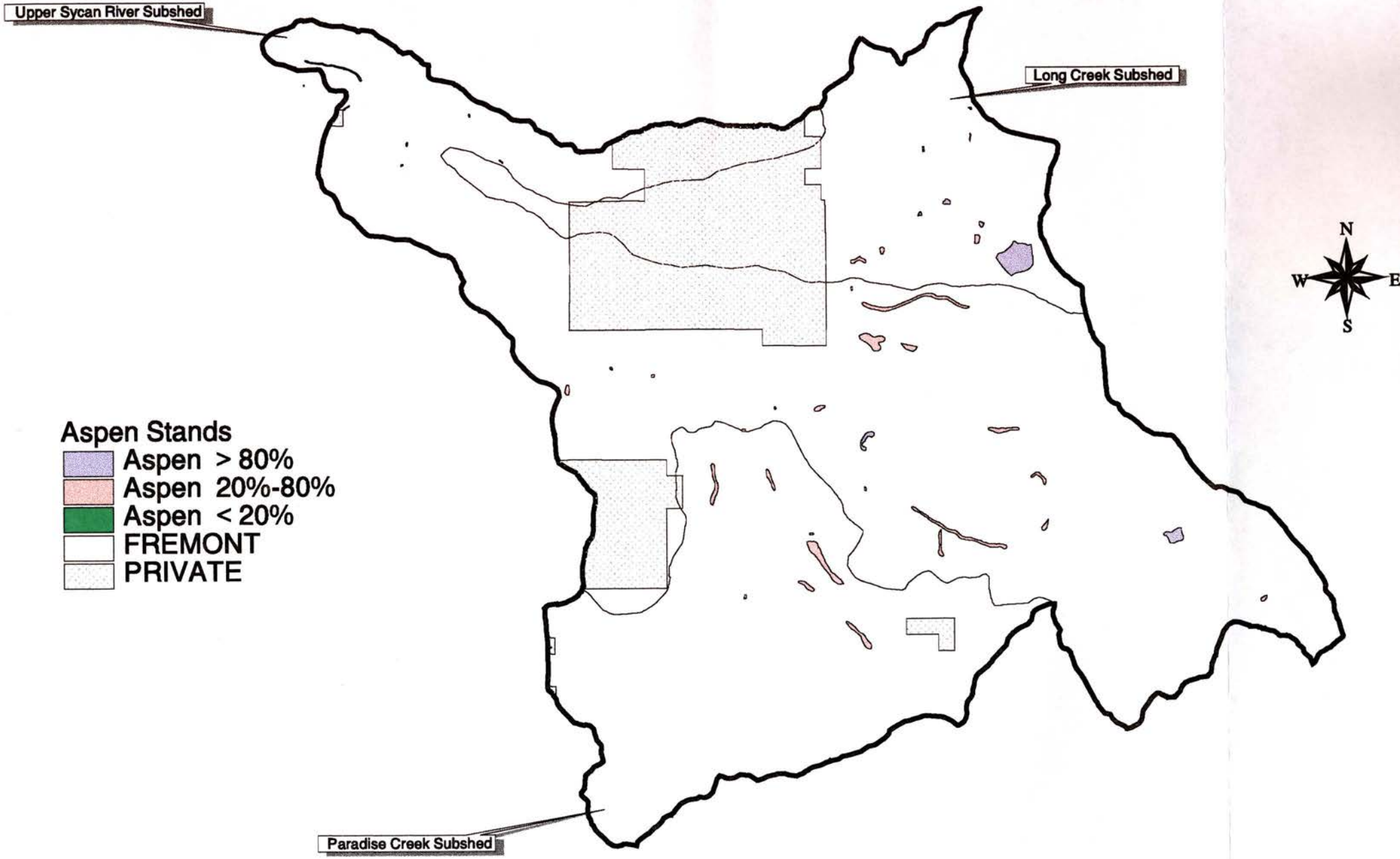
Recent literature, as compiled in ICBEMP (1997) recommendations, suggests numbers greater than the above. Consider using these recommendations where species requirements dictate in known occupied habitats.

Suggested LWD Standards in Known Occupied Habitat

Species	Pieces/Acre	Average Diameter*	Average Length	Total Lineal Length
Ponderosa pine	6	10" 25+% > 20"	30'	180'
Mixed conifer	33	15" 40% > 20"	35'	1155'
Lodgepole pine	20	10" or largest available	30'	600'

Reason: Many wildlife species rely on moderate to high levels of down logs and snags for nesting, roosting and feeding. Large down logs are a common and important habitat component of LOS forest habitats. Past management activities have greatly reduced the number and availability of snags and down logs in managed stands.

Priority Treatment Aspen Stands In Upper Sycan Watershed



Aspen/Deciduous Riparian Habitat MIS

1. Red-naped Sapsucker

Verify the location and condition, and map aspen stands where necessary on a project by project basis or through yearly monitoring activities throughout the watershed. Manage for more acres of aspen habitat than presently exists on the landscape to help move the diversity and distribution of deciduous plant communities toward the historic range of variability. Where appropriate implement small patch regeneration treatments to restore stands of shade intolerant deciduous species such as alder, willow, aspen, and dogwood.

Manage pure aspen stands to maintain the dominance of aspen stems in both the mature and early seral stages. Mature stands in poor condition will receive priority for treatment (see the map *Priority Treatment Aspen Stands In Upper Sycan Watershed*, following page (6-23). Converted stands will be protected from cattle grazing and ungulate browsing if necessary utilizing a variety of techniques. Livestock grazing of aspen suckers will be controlled where necessary until regeneration is a minimum 4-6' tall to insure stand replacement within 5 years of treatment. Fencing may be used, but only as a last resort.

Manage mixed aspen stands to maintain at least the present basal area ratio of aspen in the stand. Mixed aspen stands in the poorest condition will have highest priority for treatment - see map following page (6-23).

Implement mechanical and/or prescribed fire treatments to promote suckering in mature aspen clones that are without adequate replacement stems and still support a root system capable of responding to treatment.

Plant aspen where relic mature/decadent trees indicate site conditions are favorable for aspen establishment and growth.

> Reason: Additional aspen will help meet the habitat needs and possibly increase populations of associated wildlife species. Aspen stands are generally our most diverse plant communities in terms of both plant and animal species composition and productivity.

KNOWN DATA GAPS:

- Extent of active and historic beaver activity.
- Mapping of late seral forest cover.
- Patch and linkage (connectivity) system for LOS habitats (include late seral habitats).
- Determination and mapping of vegetative structural stages.

IV. Human Uses

Key Questions:

1. How should the watershed provide for future human uses and needs?

2. How will roads be managed to meet present and future uses and protect all resource values?

3. What logging and grazing methods may be necessary to meet resource and vegetation goals and objectives, and provide commercial products?

4. How should the watershed be managed to ensure that Treaty Rights and Trust Resources are protected?

1. In order to insure that the trust responsibilities of the United States to the Klamath Tribes are fully met within the Upper Sycan WS, incorporate the consultation procedures, as defined in the February 19, 1999 MOA, in all project planning. Specifically, include the Klamath Tribes in the initiation, development and implementation stages of all management decisions which have the potential to impact the Interstate Mule Deer herd, downstream fish populations in the Klamath Basin, cultural resources or other Treaty Right Resources. During site-specific NEPA analysis, seek to gain an understanding of traditional cultural practices that occur within the project area (such as the use of culturally significant plants). Recognize that different meanings and relationships to landscape may exist within traditional cultures than in the general public. Utilize the consultation process to gather not only current science-based information from Tribal staff, but also relevant tribal tradition-based knowledge and expertise.

2. Design and implement project work with full consideration of potential support of medium to long term family wage jobs for local work forces. For example contracts could be designed which include provisions for on going work items over several consecutive annual operating seasons. Vegetation treatments must consider the economic viability of potential wood product removal. The likelihood that small wood removal will generate trust fund dollars is diminished. Sales should be designed to accomplish as much as possible. Contracts that encompass both sale and service contracts should be developed.

3. Human uses should continue to focus around outdoor recreation activities such as camping, firewood gathering, fishing, hunting, horseback riding, off-highway vehicle (OHV) riding, mountain bike riding, cabin renting, snowmobiling and cross-country skiing.

4. Recreation activities involve camping at developed (Currier Cabin) and dispersed campgrounds (forest camps) Pike's Crossing and Rock Creek, hiking on trails (Hanan Trail) in the high country and in Sycan River canyon and seasonal hunting and fishing. The needs of the campers at Currier Cabin rental should be closely adhered to while at the same time providing the forest users at the forest camps and on the trails as much of a primitive recreation experience as possible. Opportunities in the Currier Cabin developed site need to be examined and changed and added to as needed. The idea of accessibility needs to be applied to this developed site. Consider the creation of an interpretive site (or area) in the Currier Cabin area. Provide a localized vegetative landscape condition that demonstrates pre-settlement/historic conditions in conjunction with information on ecosystem sustainability.

5. The trail system in place meets present day demands. However, future increased need would require an expansion of current facilities.

6. Interpretive activities such as signing, talks, tours and self-discovery should be facilitated as a means of adding to the experience of the forest user.

7. Designation of Off Highway Vehicle (OHV) routes use should be considered. On-the-ground surveys should be used to evaluate proposed locations.

8. Improve habitats for deer and elk to increase hunting opportunities for these species in the future.

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APPENDIX B - SPECIES LIST
(By Common Name)

Trees

Common Name	Scientific Name
Aspen	*Populus tremuloides*
Black Cottonwood	*Populus balsamifera* var. *tricharpa*
Lodgepole pine	*Pinus contorta ssp. Murrayana*
Ponderosa pine	*Pinus ponderosa*
Thinleaf alder, mountain alder	*Alnus incana*
Western juniper	*Juniperus occidentalis*
White fir	*Abies concolor*

Shrubs

Common Name	Scientific Name
Antelope bitterbrush	*Purshia tridentata*
Big sagebrush	*Artemesia tridentata*
Bog Birch	*Betula glandulosa*
Booth's Willow	*Sailix boothi*
Creeping snowberry	*Symphoricarpos mollis*
Curl-leaf mountain mahogany, mountain-mahogany	*Cercocarpus ledifolius*
Geyer Willow	*Salix geyeriana*
Greenleaf manzanita	*Arctostaphylos patula*
Low sagebrush	*Artemisia arbuscula*
Mountain big sagebrush	*Aretemesia tridentata* var vasseyana
Oregon grape	*Berberis aquifolium*
Red Osier Dogwood	*Corylus* spp
Scouler's Willow	*Salix scouleriana*
Serviceberry	*Amelanchier alnifolia*
Squawcarpet	*Ceanothus prostrates*
Wax currant	*Ribes cereum*
Whiplash Willow	*Salix lasiandra*

Grasses

Common Name	Scientific Name
Bluebunch wheatgrass	*Agropyron spicatum*
Bottlebrush squirreltail	*Sitanion hystrix*
California oatgrass	*Danthonia californica*
Cheatgrass	*Bromus tectorum*
Idaho fescue	*Festuca idahoensis*
Kentucky bluegrass	*Poa pratentis*
Meadow foxtail	*Alopecurus spp., Alopecurus pratensis*
One-spike oatgrass	*Danthonia unispicata*
Prairie junegrass	*Koeleria macrantha*
Pullup muhly	*Muhlenbergia filiformis*
Redtop	*Agrostis spp.*
Sandberg bluegrass	*Poa secunda*
Tufted hairgrass	*Deschampsia caespitosa*
Western needlegrass	*Stipa occidentalis*

Sedges and Rushes

Common Name	Scientific Name
Baltic rush	*Juncus balticus*
Beaked sedge	*Carex rostrata*
Bigleaf sedge	*Carex amplifolia*
Creeping spikerush	*Eleocharis palustris*

Sedges and Rushes (cont.)

Common Name	Scientific Name
Few-flowered spikerush	*Eleocharis pauciflora*
Long-style rush	*Juncus longistylis*
Nebraska sedge	*Carex nebraskensis*
Nevada rush	*Juncus ensifolius*
Smallwing sedge	*Carex microptera*
Sword-leaf or dagger-leaf rush	*Juncus ensifolius*
Water sedge, aquatic sedge	*Carex aquatilis*
Wooly sedge	*Carex lanuginosa*

Forbs

Common Name	Scientific Name
Biscuitroot	*Lomatium* spp
Blue-leaved penstemon	*Penstemon glaucinus*
Canada thistle	*Cirsium arvense*
Green-tinged paintbrush	*Castilleja chlorotica*
Longstem clover	*Trifolium longipes*
Musk thistle	*Carduus nutans*
Pussytoes	*Antennaria* spp
Sandwort	*Arenaria* spp
Spotted knapweed	*Centaurea maculata*
Western yarrow	*Achillea millefolium*

Pathogens

Common Name	Scientific Name
Annosus root disease	*Heterobasidion annosum*
Armillaria root disease	*Armillaria ostoyae*
Comandra blister rust	*Cronartium comandrae*
Dwarf mistletoe	*Arceuthobium* spp., *Arceuthobium ammericanum*
Indian paint fungus	*Echinodontium tinctorium* Ell & Ev.
Pine needle cast	*Lophodermella* sp.),
Stalactiform blister rust	*Cronartium coleosporioides*
Western gall rust	*Endocronartium harknessii*

Insects

Common Name	Scientific Name
Douglas-fir tussock moth	*Orgyia pseudotsugata*
Fir engraver beetle	*Scolytus ventralis*
Modoc budworm	*Choristoneura viridis* Freeman
Mountain pine beetle	*Dendroctonus ponderosae*
Pine engraver	*Ips pini*
Turpentine beetle	*Dendroctonus valens*
Western pine beetle	*Dendroctonus brevicomis*

Fish

Common Name	Scientific Name
Brook trout	*Salvelinus fontinalis*
Bull trout	*Salvelinus confluentus*
Miller Lake lamprey	*Lampetra minima*
Pit-Klamath Brook lamprey	*Lampetra lethophaga*
Redband trout	*Oncorhynchus mykiss*

Note: this list is not all inclusive (for example it does not contain the names for mammals).

SPECIES LIST

(By Scientific Name)

Trees

Scientific Name	Common Name
Abies concolor	White fir
Alnus incana	Thinleaf alder, mountain alder
Juniperus occidentalis	Western juniper
Pinus contorta ssp. Murrayana	Lodgepole pine
Pinus ponderosa	Ponderosa pine
Populus balsamifera var. *tricharpa*	Black cottonwood
Populus tremuloides	Aspen

Shrubs

Scientific Name	Common Name
Amelanchier alnifolia	Serviceberry
Arctostaphylos patula	Greenleaf manzanita
Aretemesia tridentata var vasseyana	Mountain big sagebrush
Artemesia tridentata	Big sagebrush
Artemisia arbuscula	Low sagebrush
Berberis aquifolium	Oregon grape
Betula glandulosa	Bog Birch
Ceanothus prostrates	Squawcarpet
Cercocarpus ledifolius	Curl-leaf mountain mahogany, mountain-mahogany
Corylus spp	Red Osier Dogwood
Purshia tridentata	Antelope bitterbrush
Ribes cereum	Wax currant
Sailix boothi	Booth's willow
Salix geyeriana	Geyer willow
Salix lasiandra	Whiplash willow
Salix scouleriana	Scouler's willow
Symphoricarpos mollis	Creeping snowberry

Grasses

Scientific Name	Common Name
Agropyron spicatum	Bluebunch wheatgrass
Agrostis spp.	Redtop
Alopecurus spp., Alopecurus pratensis	Meadow foxtail
Bromus tectorum	Cheatgrass
Danthonia californica	California oatgrass
Danthonia unispicata	One-spike oatgrass
Deschampsia caespitosa	Tufted hairgrass
Festuca idahoensis	Idaho fescue
Koeleria macrantha	Prairie junegrass
Muhlenbergia filiformis	Pullup muhly
Poa pratentis	Kentucky bluegrass
Poa secunda	Sandberg bluegrass
Sitanion hystrix	Bottlebrush squirreltail
Stipa occidentalis	Western needlegrass

Sedges and Rushes

Scientific Name	Common Name
Carex amplifolia	Bigleaf sedge
Carex aquatilis	Water sedge, aquatic sedge
Carex lanuginosa	Wooly sedge

Sedges and Rushes (cont.)

Scientific Name	Common Name
Carex microptera	Smallwing sedge
Carex nebraskensis	Nebraska sedge
Carex vesicaria	Inflated sedge
Eleocharis palustris	Creeping spikerush
Eleocharis pauciflora	Few-flowered spikerush
Juncus balticus	Baltic rush
Juncus ensifolius	Sword-leaf or dagger-leaf rush
Juncus ensifolius	Nevada rush
Juncus longistylis	Long-style rush

Forbs

Scientific Name	Common Name
Achillea millefolium	Western yarrow
Antennaria spp	Pussytoes
Arenaria spp	Sandwort
Carduus nutans	Musk thistle
Castilleja chlorotica	Green-tinged paintbrush
Centaurea maculata	Spotted knapweed
Cirsium arvense	Canada thistle
Lomatium spp	Biscuitroot
Penstemon glaucinus	Blue-leaved penstemon
Trifolium longipes	Longstem clover

Pathogens

Scientific Name	Common Name
Arceuthobium spp., *Arceuthobium ammericanum*	Dwarf mistletoe
Armillaria ostoyae	Armillaria root disease
Cronartium coleosporioides	Stalactiform blister rust
Cronartium comandrae	Comandra blister rust
Echinodontium tinctorium Ell & Ev.	Indian paint fungus
Endocronartium harknessii	Western gall rust
Heterobasidion annosum	Annosus root disease
Lophodermella sp.),	Pine needle cast

Insects

Scientific Name	Common Name
Choristoneura viridis Freeman	Modoc budworm
Dendroctonus brevicomis	Western pine beetle
Dendroctonus ponderosae	Mountain pine beetle
Dendroctonus valens	Turpentine beetle
Ips pini	Pine engraver
Orgyia pseudotsugata	Douglas-fir tussock moth
Scolytus ventralis	Fir engraver beetle

Fish

Scientific Name	Common Name
Lampetra lethophaga	Pit-Klamath Brook lamprey
Lampetra minima	Miller Lake lamprey
Oncorhynchus mykiss	Redband trout
Salvelinus confluentus	Bull trout
Salvelinus fontinalis	Brook trout

Note: this list is not all inclusive (for example it does not contain the names for the mammals).

APPENDIX C

GLOSSARY For UPLAND FOREST VEGETATION

A

Abiotic factors: the non-living components of the environment, such as air, rocks, soil, water, peat, and plant litter.

Adaptive management: adaptive management rigorously combines management, research, monitoring, and means of changing practices so that credible information is gained and management activities are modified by experience.

Advanced regeneration: trees that have become established naturally under a mature forest canopy and are capable of becoming the next crop after the mature crop is removed.

Artificial regeneration: establishing a new forest by planting seedlings or by direct seeding (as opposed to natural regeneration).

B

Basal area per acre: A term that defines forest stand density. The area of the cross-section of tree stems near their base, generally at breast height and including bark, measured over 1 acre of land.

Baseline information: information collected to provide a standard against which future measurements can be compared.

Biodiversity (biological diversity): the diversity of plants, animals, and other living organisms in all their forms and levels of organization, including genes, species, ecosystems, and the evolutionary and functional processes that link them.

Breast height: the standard height, 4.5 feet above ground level, at which the diameter of a standing tree is measured.

C

Cambium: a single layer of cells between the woody part of the tree and the bark. Division of these cells results in diameter growth of the tree through formation of wood cells (xylem) and inner bark (phloem).

Canopy: the forest cover of branches and foliage formed by tree crowns.

Canopy closure: the progressive reduction of space between crowns as they spread laterally, increasing canopy cover.

Canopy cover: the percentage of a fixed area covered by crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of the foliage.

Carrying capacity: the average number of livestock and wildlife, or plants that can be sustained on a management unit, compatible with management objectives for the unit. It is a function of site characteristics, management goals, and management intensity.

Clone: genetically identical individuals propagated from a common parent. Most aspen stands are clones originated from only a few ancestral parents. See coppice regeneration.

Codominant: in stands with a closed canopy, those trees whose crowns form the general level of the canopy and receive full light from above, but comparatively little from the sides. In young stands, those trees with above average height growth.

Commercial thinning: a silviculture treatment that 'thins' out an overstocked stand by removing trees that are large enough to be sold as products. It is carried out to improve the health and growth rate of the remaining crop trees.

Competing vegetation: vegetation that seeks and uses the limited common resources (space, light, water, and nutrients) of a forest site needed by preferred trees for survival and growth.

Conifer: cone-bearing trees having needles or scale-like leaves, usually evergreen, and producing wood known commercially as 'softwoods'.

Conifer release: to 'release' established coniferous trees from a situation in which they have been suppressed by thinning out undesirable trees and shrubs that have overtopped them. Carried out to improve the growth of the coniferous trees released.

Coppice (coppicing): the tendency of certain tree and brush species (such as aspen) to produce a large number of shoots when a single or few stems are disturbed.

Corridor: a band of vegetation, usually older forest, which serves to connect distinct patches on the landscape. Connectivity permits the movement of plant and animal species between what would otherwise be isolated patches.

Crown Ratio: The percent of the compacted portion of the tree bole or shrub supporting green, live, healthy foliage when compared to the total length or height. Often termed live crown ratio (LCR).

D

DBH (diameter at breast height): the stem diameter of a tree measured at breast height, 4.5 feet above the ground.

Disturbance: a discrete event, either natural or human-induced, that causes a change in the existing condition of an ecological system.

Dominant: trees with crowns extending above the general level of the canopy and receiving full light from above and partly from the side; taller than the average trees in the stand with crowns well developed.

E

Ecotone: a transition area between two adjacent ecological communities usually exhibiting competition between organisms common to both. A relatively small inclusion of a different ecological community due to a subtle change in soil or aspect (for example).

Even-aged stand: a stand of trees consisting of one or two age classes. Even-aged stands are often the result of fire, or a harvesting method such as clearcutting or seedtree.

F

Feller-buncher: a harvesting machine that cuts a tree with shears or a saw and then piles it.

Forest type: a group of forested areas or stands of similar composition (species, age, height, and stocking), which differentiates it from other, such groups.

Fragmentation: the process of transforming large continuous forest patches into one or more smaller patches surrounded by disturbed areas. This occurs naturally through such agents as fire, landslides, windthrow and insect attack. In managed forests timber harvesting and related activities have been the dominant disturbance agents.

G

Genetic diversity: variation among and within species that is attributable to differences in hereditary material.

Geographic information system (GIS): a computer system designed to allow users to collect, manage and analyze large volumes of spatially referenced information and associated attribute data.

Girdling: to kill a tree by severing or damaging the cambium layer and interrupting the flow of food between the leaves and the rest of the tree. A method of 'brushing' carried out using a hatchet or special tool to cut through the bark and cambium of the tree.

Goshawk foraging area: areas where prey are searched for and captured by goshawks. Desired size of foraging areas is approximately 5400 acres (not including nest stand and post fledgling area).

Goshawk nest area: The nest tree and stand surrounding the nest that contains prey handling areas, perches and roosts. Often referred to as the nest stand, usually approximately 30 acres in area.

Ground-based systems: logging systems that employ ground-based equipment such as feller-bunchers, skidders, and forwarders.

H

Habitat: the place where an organism lives and/or the conditions of that environment including the soil, vegetation, water, and food.

Hardwoods: trees, which are generally deciduous, broad leafed species such as aspen, alder or willow.

Harvesting: the practice of felling and removing trees or the removal of dead or damaged trees from an area.

Harvesting method: the mix of felling, bucking, and yarding (skidding) systems used in logging a stand of timber.

Harvesting prescription: detailed plan on how, when, and where timber will be harvested from an area.

Harvesting system: the mix of felling, bucking and yarding systems used in logging a stand of timber.

High energy site: opposite of low energy site. Site more prone to pine than fir. See low energy site.

Highgrading: the removal of only the best trees from a stand, often resulting in a residual stand of poor quality trees.

Historical range of variation (HRV): the range of the spatial, structural, compositional and temporal characteristics of ecosystem elements during a period specified to represent "natural" conditions.

I

Increment: the increase in diameter, basal area, height, volume, quality or value of individual trees or stands during a given period.

Intermediate: intermediate trees have crowns below, but still extending into, the general level of the canopy and receive a little direct light from above but none from the sides.

Intertree distance: the distance between tree boles usually used in the context of thinning. Recommended guidelines for intertree distances are established for different thinning programs depending on site variables, the species and age of trees, and management objectives.

J

Juvenile spacing: a silvicultural treatment to reduce the number of trees in young stands, often carried out before the stems removed are large enough to be used or sold as a forest product. Prevents stagnation and improves growing conditions for the remaining crop trees so that at final harvest the end product quality and value is increased. Also called precommercial thinning.

L

Ladder fuels: fuels that provide vertical continuity between the surface fuels and crown fuels in a forest stand, thus contributing to the ease of torching and crowning.

Landscape: the fundamental traits of a specific geographic area, including its biological composition, physical environment and anthropogenic or social patterns.

Landscape ecology: the study of the distribution patterns of communities and ecosystems, the ecological processes that affect those patterns and changes in pattern and process over time.

Landscape level: a watershed, or series of interacting watersheds or other natural biophysical (ecological) units, within the larger Land and Resource Management Planning areas. This term is used for conservation planning and is not associated with visual landscape management and viewscape management.

Leave trees: all trees, regardless of species, age, or size, remaining on a harvested area as a result of a predetermined silviculture prescription to address a possible range of silviculture or resource needs.

Lopping and scattering: lopping the slash created after felling and spreading it more or less evenly over the ground.

LOS: late or old structural stage. Referenced to the seral stage of forest stands. Old growth forests are LOS but LOS is not necessarily old growth.

Low energy sites: usually a north or northeast facing slope where the combination of aspect and elevation will vary the surrounding plant association. Site more prone to fir than pine. See ecotone

M

Management zones: often referred to in terms of an upper and lower management zones, a prescribed level of stand density. Stands managed within management zones should grow predictably.

Mechanical site preparation: any activity that involves the use of mechanical machinery to prepare a site for reforestation.

Microsite: a small area that exhibits localized characteristics different from the surrounding area. For example, the microsites created by a rock outcrop with thin soils, or the shaded and cooled areas created on a site by the presence of slash.

Mixed stand: a stand composed of two or more tree species.

Mycorrhiza: a rootlet of a higher plant modified through integral association with a fungus to form a constant structure which differs from either component but is attached to the root system and functions somewhat as a rootlet. It is usually considered to be beneficial to the associated plant.

N

Natural disturbance regimes: the historic patterns (frequency and extent) of fire, insects, wind, landslides and other natural processes in an area.

Natural regeneration: the renewal of a forest stand by natural seeding, sprouting, suckering, or layering seeds may be deposited by wind, birds or mammals.

NEPA: National Environmental Policy Act

Non-forest land: land not primarily intended for growing or supporting a forest.

O

Objective: the end result(s) that must be achieved through management at any given administrative level. Objectives are quantified and indicate time and agency responsibility.

Old growth: old growth is a forest that contains live and dead trees of various sizes, species, composition, and age class structure. Old-growth forests, as part of a slowly changing but dynamic ecosystem, include climax forests but not sub-climax or mid-seral forests. The age and structure of old growth varies significantly by forest type and from one biogeoclimatic zone to another.

Old-growth attributes: structural features and other characteristics of old-growth forests, including: large trees for the species and site; wide variation in tree sizes and spacing; accumulations of large dead standing and fallen trees; multiple canopy layers; canopy gaps and understory patchiness; elements of decay such as broken or deformed tops or trunks and root decay; and the presence of species characteristic of old growth.

Orthophoto: a completely rectified copy of an original photograph. All variations in scale and displacements, due to relief, have been eliminated, hence the name ortho (correct) photography. Orthophoto and orthophoto map are synonymous, an orthophoto is, very simply, a photomap.

Overstory: that portion of the trees in a forest of more than one story forming the upper or uppermost canopy layer.

P

Partial cutting: Refers generically to stand entries, under any of the several silvicultural systems, to cut selected trees and leave desirable trees for various stand objectives. Partial cutting includes harvest methods used for seed tree, shelterwood, selection, and clearcutting with reserves systems.

Patch: in landscape ecology, a particular unit with identifiable boundaries that differs from its surroundings in one or more ways. These can be a function of vegetative composition, structure, age or some combination of the three.

Patch cutting: a silvicultural system that creates openings, generally, less than 5 acres in size and is designed to manage each opening as a distinct even-aged opening.

Phloem: a layer of tree tissue just inside the bark that conducts food from the leaves to the stem and roots. See Cambium.

Pioneer plants: a succession term for plants capable of invading bare sites, such as a newly exposed soil surface, and persisting there, i.e., 'colonizing' until supplanted by invader or other succession species.

Pitch tubes: a tubular mass of resin that forms on the surface of bark at bark-beetle entrance holes.

Plant Association: an assemblage of plants occurring as a climax community or biological potential for that site.

Plant community: an assemblage of plants occurring together at any point in time, thus designating no particular ecological status.

Post-fledgling area (PFA): The area of concentrated use by the goshawk family after the young leave their nest. The desired area is approximately 420 acres.

Precommercial thinning: see Juvenile spacing.

Prescribed burning: the knowledgeable application of fire to a specific unit of land to meet predetermined resource management objectives.

Prescription: a course of management action prescribed for a particular area after specific assessments and evaluations have been made.

Q

Quadratic mean diameter: dq = sqrt ((sum of squared diameters)/n)

R

Reforestation: the natural or artificial restocking (i.e., planting, seeding) of an area with forest trees. Also called forest regeneration.

Release: freeing a tree or group of trees from more immediate competition by cutting or otherwise eliminating growth that is overtopping or closely surrounding them.

Residual stand structure: the age class or height structure of the stand or remaining trees after harvesting.

Residuals (residual trees): trees left standing after harvesting.

Resilience: the ability of an ecosystem to maintain diversity, integrity and ecological processes following disturbance.

Restoration: the return of an ecosystem or habitat or part there of to its original community structure, natural complement of species and natural functions.

Risk: the probability of an undesirable event occurring within a specified period of time. With regard to insect populations, risk involves components to evaluate the likelihood of an outbreak, the likelihood of trees being attacked (susceptibility) or the likelihood of trees being damaged (vulnerability). In fire prevention, risk involves those things or events that cause fires to start (including the physical igniting agents and people).

S

Salvage harvesting: logging operations specifically designed to remove damaged timber (dead or in poor condition) and yield a wood product. Often carried out following fire, insect attack or windthrow.

Sapling: a loose term for a young tree no longer a seedling but not yet a pole.

Scarification: a method of seedbed preparation that consists of exposing patches of mineral soil through mechanical action.

SDI_{max}: The highest density a given plant association can obtain before stand mortality will approach stand growth. Often referred to as normal stocking. Bark beetles often infest stands at densities far below normal stocking.

Seed tree silvicultural system: an even-aged silvicultural system in which selected trees (seed trees) are left standing after the initial harvest to provide a seed source for natural regeneration. Seed trees can be left uniformly distributed or in small groups. Although regeneration is generally secured naturally, it may be augmented by planting. Seed trees are often removed once regeneration is established or may be left as reserves.

Seed trees: trees selected to be left standing to provide seed sources for natural regeneration. Selection is usually on the basis of good form and vigor, the absence of serious damage by disease, evidence of the ability to produce seed, and wind firmness.

Seedbed: in natural regeneration, the soil or forest floor on which seed falls; in nursery practice, a prepared area over which seed is sown.

Seedling: a young tree, grown from seed, from the time of germination to the sapling stage, having a DBH equal or less than one inch.

Selection silvicultural system: a silvicultural system that removes mature timber either as single scattered individuals or in small groups at relatively short intervals, repeated indefinitely, where the continual establishment of regeneration is encouraged and an uneven-aged stand is maintained.

Seral stage: any stage of development of an ecosystem from a disturbed, unvegetated state to a climax plant community.

Shade tolerance: the capacity of a tree or plant species to develop and grow in the shade of, and in competition with, other trees or plants.

Shelterwood silvicultural system: a silvicultural system in which trees are removed in a series of cuts designed to achieve a new even-aged stand under the shelter of remaining trees.

Silvics: the study of the life history, requirements and general characteristics of forest trees and stands in relation to the environment and the practice of silviculture.

Silvicultural system: planned programs of treatments throughout the life of the stand to achieve stand structural objectives based on integrated resource management goals. A silvicultural system includes harvesting, regeneration and stand-tending methods or phases. It covers all activities for the entire length of a rotation or cutting cycle.

The Society of American Foresters (SAF) identifies six major categories of silvicultural system: five even-aged systems and one uneven-aged system. Even-aged categories include the clearcut, patch-cut, coppice, seed tree and shelterwood systems. Uneven-aged systems are termed selection silvicultural systems.

Silviculture: the art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Silviculture prescription: a site-specific operational plan that describes the forest management objectives for an area. It prescribes the method for harvesting the existing forest stand, and a series of silviculture treatments that will be carried out to establish a free growing stand in a manner that accommodates other resource values as identified.

Silviculture regime: a series of site-specific silviculture treatments planned over time.

Site: an area described or defined by its biotic, climatic, and soil conditions in relation to its capacity to produce vegetation; the smallest planning unit.

Site class: the measure of the relative productive capacity of a site for a particular crop or stand, generally based on tree height at a given age and expressed as either good, medium, poor or low.

Site index: an expression of the forest site quality of a stand, at a specified age, based either on the site height, or on the top height, which is a more objective measure.

Site preparation: the treatment of the soil and ground vegetation to prepare the soil surface as a favorable seedbed for either naturally or artificially disseminated seed or for planted seedlings.

Site productivity: the inherent capabilities of a site to produce or provide the commodities or values for which the area will be managed in accordance with predetermined management objectives.

Skid road: a bladed or backhoe-constructed pathway where stumps are removed within the running surface as necessary. Skid roads are suitable only for tracked or rubber-tired skidders bringing trees or logs from the felling site to a landing.

Skid trail: a random pathway traveled by ground skidding equipment while moving trees or logs to a landing. A skid trail differs from a skid road in that stumps are cut very low and the ground surface is mainly untouched by the blades of earth moving machines.

Slash: the residue left on the ground as a result of forest and other vegetation being altered by forest practices or other land use activities.

Softwoods: cone-bearing trees with needle or scale-like leaves such as Douglas fir, incense cedar and ponderosa pine.

Spacing: the removal of undesirable trees within a young stand to control stocking, to maintain or improve growth, to increase wood quality and value, or to achieve other resource management objectives.

Species composition: the percentage of each recognized tree species comprising the forest type based upon the gross volume, the relative number of stems per hectare or basal area.

Species conversion: a change from one tree species to another.

Stand: a community of trees sufficiently uniform in species composition, age, arrangement, and condition to be distinguishable as a group from the forest or other growth on the adjoining area, and thus forming a silviculture or management entity.

Stand composition: the proportion of each tree species in a stand expressed as a percentage of either the total number, basal area or volume of all tree species in the stand.

Stand density: a relative measure of the amount of stocking on a forest area. Often described in terms of stems per acre, basal area, or stand density index.

Stand density Index: The number of trees per acre that a stand would have at a quadratic mean diameter of 10 inches.

Stand development: the part of stand dynamics concerned with changes in stand structure over time.

Stand dynamics: the study of changes in forest stand structure over time, including stand behavior during and after disturbances.

Stand level: the level of forest management at which a relatively homogeneous land unit can be managed under a single prescription, or set of treatments, to meet well-defined objectives.

Stand management prescription: A site-specific operational plan describing the nature and extend of silviculture activities planned for a free growing stand of trees to facilitate the achievement of specified or identified social, economic and environmental objectives.

Stand model: a computer model that forecasts the development of a forest stand, usually in terms of stand attributes such as mean diameter or height. The Forest Vegetation Simulator (FVS) is a stand model.

Stand structure: the distribution of trees in a stand, which can be described by species, vertical or horizontal spatial patterns, size of trees or tree parts, age, or a combination of these.

Stand tending: a variety of forest management treatments, including spacing, fertilization, pruning, and commercial thinning, carried out at different stages during a stand's development.

Stocking: a measure of the area occupied by trees, usually measured in terms of well- spaced trees per acre, or basal area per acre, relative to an optimum or desired level.

Succession: the gradual supplanting of one community of plants by another, the sequence of communities being termed a sere and each stage seral.

Suppressed trees: Trees or shrubs with crowns receiving no direct light either from above or from the sides, and that will not respond to release. Usually crowns are entirely below the general level of the canopy.

Sustainable forest management: management regimes applied to forestland that maintain the productive and renewal capacities as well as the genetic, species and ecological diversity of forest ecosystems.

T

Thinning: a cutting made primarily in an immature crop or stand to accelerate diameter increment but also, by suitable selection, to improve species distribution.

Timber: trees, whether standing, fallen, living, dead, limbed, bucked or peeled.

Understory: any plants growing under the canopy formed by other plants, particularly herbaceous and shrub vegetation under a tree canopy.

U

Uneven-aged silvicultural system: a silvicultural system designed to create or maintain and regenerate an uneven-aged stand structure. Singletree and group selection are uneven-aged silvicultural systems.

Uneven-aged stand: a stand of trees containing three or more age classes. In a balanced uneven-aged stand, each age class is represented by approximately equal areas, providing a balanced distribution of diameter classes.

Uplands: terrain not affected by water table or surface water or else affected only for short periods so that riparian (hydrophilic) vegetation or aquatic processes do not persist.

V

Vegetation Treatments: Any planned manipulation of plant materials. Prescribed burning, thinning, logging, lopping are all examples of vegetation treatments.

W

Watershed: an area of land that collects and discharges water into a single main stream through a series of smaller tributaries.

Y

Yarding (yarding systems): in logging, the hauling of felled timber to the landing or temporary storage site from where trucks (usually) transport it to the mill site. Yarding methods include cable yarding, ground skidding, and aerial methods such as helicopter and balloon yarding.

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