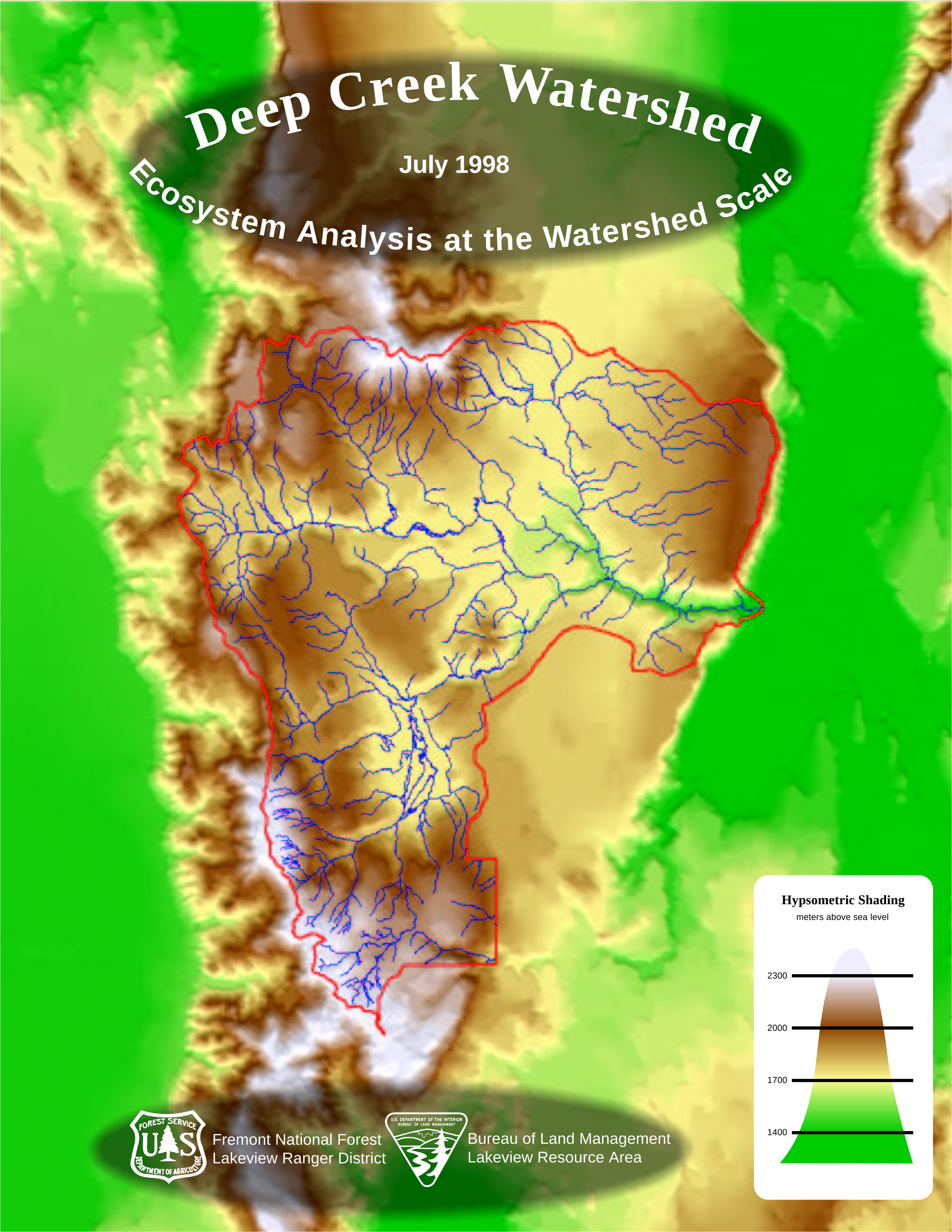
Deep Creek Watershed

July 1998

Ecosystem Analysis at the Watershed Scale



Fremont National Forest
Lakeview Ranger District

Bureau of Land Management
Lakeview Resource Area

DEEP CREEK WATERSHED
Ecosystem Analysis at the Watershed Scale

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INTRODUCTION

It is the goal of the federal agencies to have healthy ecosystems which provide sustainable and beneficial uses to the public. Watershed analysis looks at the ecosystem as a whole and not just the individual parts. This analysis provides a logical way to learn more about how ecological systems function within the watershed by incorporating knowledge specific to the watershed into the planning process. It is intended to help the agencies gain a better understanding of how past land use activities interact with the physical and biological environments in the watershed. This information is essential to protect and sustain the beneficial uses and to protect the natural systems occurring within the watershed. This document presents a current understanding of the processes and interactions of concern occurring within the Deep Creek watershed.

The Deep Creek watershed is located in southcentral Oregon (see Map 1). The southern tip extends into California. There are 15 subsheds (180,046 acres) within the watershed. Map 2 identifies the subsheds and ownership. Public lands account for 68% of the watershed: USDA Forest Service, Lakeview Ranger District, 36%; USDI, Bureau of Land Management, Lakeview District, Lakeview Resource Area, 31%; and the State of Oregon and Modoc National Forest (California), 1%. The remaining 32% is in private ownership.

The watershed is within the Basin and Range physiographic province characterized by fault-block mountains enclosing basins with internal drainages. It is located in the Warner Mountains immediately to the east of Lakeview, Oregon and includes Drake Peak (8,407 feet), Rogger Peak (7,302 feet) and Crane Mountain (8,456 feet). This range is the southern continuation of Abert Rim, the largest exposed fault on the North American Continent, and is a series of north to south running ridges separating Goose Lake Valley from the eastern Oregon high desert. It is in the semiarid rain shadow region east of the Cascade Mountains characterized by cool temperatures, light precipitation and moderate winds. The watershed is not prone to large scale fire disturbances. Basalt and tuff derived soils are the most common. Three vegetation types dominate the watershed: upland forest, riparian and rangeland. Forested vegetation consists of ponderosa pine, lodgepole pine, mixed conifer and juniper woodlands. Seventy percent of riparian vegetation is on private land. On National Forest System lands, the majority of riparian acres support coniferous and deciduous tree cover. Herbaceous meadows are the second greatest vegetation. Riparian vegetation on BLM-administered lands are represented by silver sagebrush-grass types in drier areas and grasslike types which include sedges, rushes and bluegrass. Dominant vegetation on rangeland is low sagebrush-grass and mountain big sagebrush-grass. Eight sensitive plant species are known to occur in the watershed.

The watershed contains 517 miles of streams. In general, National Forest System lands are at the headwaters and upper reaches of the watershed, private lands occupy the middle elevation meadow areas and BLM-administered lands are in the lower elevation areas. Water uses include the Town of Lakeview, irrigation, livestock and wildlife, fisheries habitat and road dust abatement.

Wildlife habitats support a variety of species including the northern bald eagle and American peregrine falcon, federally listed threatened and endangered species respectively. The Warner sucker and Warner Valley redband trout and their habitats also occupy the watershed. The Warner sucker is a federally listed threatened species and the redband trout is a USDA Forest Service Pacific Northwest Region Sensitive Species. Other sensitive species include the western sage grouse and California bighorn sheep. Mule deer, elk, pronghorn antelope and rainbow, redband and brook trout comprise the major game species.

Timber harvest, road construction and cattle/sheep grazing has occurred within the majority of the watershed. Most of the timber stands on public land have been entered in the last fifty years to remove large ponderosa pine. Many stands have been entered a second or third time. A road system was constructed to support timber harvest. Early livestock grazing (1870-1940) on public land occurred year-round with no regulation on the number or type of livestock. Presently, there are 20 grazing allotments.

The analysis was conducted by an 11-member interagency core team from the Fremont National Forest Supervisor's Office and the Lakeview Resource Area, Lakeview District, Bureau of Land Management consisting of a hydrologist, wildlife biologists, fisheries biologist, silviculturist, range management specialist and archaeologist. Watershed assessment data was provided to the core team by district/area specialists. The team followed the six-step process outlined in Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis. The process includes: characterization of the watershed, identification of issues and key questions, description of current conditions, description of reference conditions, synthesis and interpretation of information and management recommendations. Each of the steps are further evaluated in relationship to seven core topics: erosion processes, hydrology, vegetation, stream channel, water quality, terrestrial and aquatic species and habitats and human uses.

This document reports the findings of the core team. **It is not a decision document**, nor does it make changes in land allocation or select specific projects to be implemented. Individual land use or resource management plans have been developed by the Fremont National Forest and the Lakeview Resource Area, Lakeview District, Bureau of Land Management which relate to or otherwise govern how management is carried out within the watershed. The Lakeview Ranger District and Lakeview Resource Area will use this analysis to select specific projects that will move the watershed toward the desired future condition. These projects will then be addressed through separate analyses conducted on a project-by-project basis by a district/area interdisciplinary team. The project analysis process will include involvement by the public and result in a site-specific decision as required by the National Environmental Policy Act.

STEP 1. CHARACTERIZATION OF THE WATERSHED

The purpose of characterization is to identify the dominant physical, biological, and human processes and features of the watershed that affect ecosystem functions and conditions. The core team also considered the status of land allocations, plan objectives and regulatory constraints that influence resource management for the watershed. This section identifies the primary ecosystem elements needing more detailed analysis in subsequent sections.

Erosion Processes

The primary sources of sediment due to management activities are road, logging and stream bank erosion. Roads have the greatest erosion rate and are the largest source of sediment in the high elevation areas of the watershed. Erosion from timber harvest is approximately 1/2 that from roads. There are four major geologic parent materials which result in different erosion rates (Table 1).

Table 1. Geologic Erosion Rates

Geologic Parent Material	Geologic Period	% of Watershed	Geologic Erosion Factor
Alluvial	Quaternary	9	1.05
Olivine basalt	Quaternary	59	0.42
Rhyolite	Tertiary	6	1.00
Tuffaceous sedimentary rocks/pumicites	Tertiary	23	0.66

The forested basalt and tuff derived soils have low to moderate surface erosion rates and a low risk of mass movement. These soils are resistant to erosion and weather into clays which hold the soil together. However, they are highly susceptible to compaction from management activities which reduces infiltration and increases overland flow and erosion. Shallower soils have high erosion risks due to restricted infiltration and percolation rates. Overland flow is common on these soil types.

Soils derived from rhyolite are moderately deep to deep. Rhyolitic soils have a moderate to high risk of rill and gully erosion because of their loose coarse texture and the steep landforms on which they occur. The risk of compaction is low. The risk of mass movement (debris avalanche) is low, but it does occur on the steeper slopes. Rotational slumps do not occur on these soil/bedrock materials.

Hydrology

A. Climate

The watershed is located in the semiarid rain shadow region east of the Cascade Mountains. This area has both maritime and continental climate patterns, with most of the weather patterns moving inland on cyclonic low pressure fronts off the Pacific coast. Maritime air masses are blocked by the Cascade Mountain Range and the Warner Mountains. This results in the east side of the Warner Mountains receiving slightly less snow than the west side. The majority of precipitation falls as snow, with higher elevations receiving greater depths of snow.

Temperatures also vary widely, both seasonally and by elevation. Summer highs exceed 100^{o}F in the lower elevations and winter lows well below 0^{o}F at any elevation. Freezing temperatures can occur any time of the year, especially at high elevations. Higher elevation areas have a progressively shorter growing season, especially above 6,000 feet.

B. Water Quantity

Rain on snow events periodically occur in December or January and result in the highest flow events. Normal spring runoff occurs from March through June with May usually producing the highest flows in Deep Creek. March produces the highest flows in Twentymile and Drake Creeks. The higher elevations are a significant source of flow for both base flow and spring runoff. The low elevation areas contribute more towards spring runoff with less influence on base flow.

Current peak flows with a return frequency of five to 50 years appear to be 10 to 30% higher than historic flows. The gauging records show less change in the 1.5 and 100 year return periods. Deep Creek experienced peak flows exceeding a 100 year event in 1964. Possible causes of increased peak flows are linked to the effects of high road densities and high levels of compacted soil from logging.

The understory forest canopy has generally increased and forested stands now have higher canopy than the mean of historic conditions. However, the forested canopy is within the natural range of variability for the watershed and closer to the mean than the outside range. Also clearcuts or burn areas are less than 12% of any subshed. Research shows that this level of impact has little effect on increased runoff.

Base flows are estimated to have decreased a small amount as compared to historic conditions. Encroachment of conifers/junipers in meadows and stringers, downcutting of streams, loss of beaver dams and interception by roads create conditions for less base flow.

Mean monthly flows have changed little since historic times, however duration of flows at bankfull have increased. This increase in high flows results in additional scour potential to the channel that can add to bank erosion.

Vegetation

A. Upland (Forest) Vegetation

The forested portion of the watershed lies on the east slopes of Crane Mountain and the upper slopes of the Camas Creek drainage in the Warner Range. The eastern slopes of Crane Mountain are influenced by the rain shadow effects of the mountain's elevation; 8,456 feet at its highest point. The mountain is actually a series of north to south running ridges separating the Goose Lake Valley from the eastern Oregon high desert.

The upper eastern slope of Crane Mountain above 8,000 feet is generally above tree line. Slopes just below 8,000 feet are generally subalpine consisting of open meadows and white barked pine.

Camas Creek flows west to east through the northern part of the watershed along Oregon State Highway 140. The vegetation pattern of this area is more typical of west/east flowing drainages with the drier southern slopes containing more ponderosa pine. The slightly wetter northern slopes have a greater component of white fir with some stands of pure white fir at higher elevations.

Most of the timber stands on public land have been entered in the last fifty years to remove large valuable ponderosa pine. Many stands have been entered a second or third time to remove remaining large overstory pine and white fir, while culturing the second growth understory. Many of these stands had an understory of 60 to 80 year old white fir. Several were thinned to capture growing space and increase growth. Clearcutting of many stands occurred in the 1980s where the residual growing stock was badly damaged from previous entries, suppressed or undergoing mortality from insects and disease. Stand regeneration generally has been successful. Most clearcut sites have been restocked to ponderosa pine.

The Warner Range was not as heavily attacked by fir engraver bark beetles (Scolytus ventralis) as the rest of the Lakeview Ranger District during the drought of the 1980s and early 1990s. It has been attacked by epidemic outbreaks of the green phase of the spruce budworm (Choristoneura occidentallis), known as the Modoc budworm (Choristone ura viridis, Freeman). This budworm phase seems to be native to the Warner Mountain Range of southern Oregon and northern California. Attacks seem to occur on a 10 to 15 year cycle. The Modoc budworm population seems to ebb and flow with a naturally occurring virus that causes outbreaks to crash quickly. Defoliation of the new shoots and first year needles usually results in some top kill but rarely in tree mortality.

The watershed is not prone to large scale fire disturbances. Storm tracks which produce lightning usually skirt the Warners proceeding northeast across the open desert or flowing up over the western part of the forest.

B. Rangeland

Vegetation off the Fremont National Forest is predominantly nonforested. There are about 84,000 acres of BLM-administered (67%) and privately (33%) owned lands. The dominant vegetation is low sagebrush-grass and mountain big sagebrush-grass with western juniper as an overstory. Low sagebrush-grass occupies about 53% of the total area (62% of BLM acres) and 25% of that is in the late seral stage with Idaho fescue being the most common understory grass. Mountain big sagebrush-grass occupies about 12% of both the BLM acreage and the total area. Western juniper-low sagebrush-grass comprises about 3% of the total area and 5% of BLM-administered lands. Many of the large old growth (125 years or older) junipers are found in this plant community. Western juniper-mountain big sagebrush-grass type comprises about 9% of BLM and total area. Only about 3% of the total area contains vegetation associated with riparian areas or wetlands.

Other shrub communities that occupy small percentages but may be very important include silver sagebrush, mountain mahogany, antelope bitterbrush and some small areas of mixed pine and fir trees. There are also inclusions of important plant populations such as snowberry and aspen.

Antelope bitterbrush or mountain mahogany is the dominant vegetation in only about 3% of the total acres in the BLM portion of the watershed. About 5% of these acres are in the climax seral stage and 42% in the late seral stage. These unique and relatively rare types are very important habitat for deer and other wildlife species.

The most common grasses found in the understory include Sandberg's bluegrass, bottlebrush squirreltail, Idaho fescue, bluebunch wheatgrass and Thurber's needlegrass. These grass species are often growing together, but one or two are usually the dominant species at a given site depending on soils, topography and previous disturbance. In low sagebrush, the dominant grasses are Sandberg's bluegrass (42%), bottlebrush squirreltail (29%) and Idaho fescue (23%). In mountain big sagebrush, the dominant grasses are bluebunch wheatgrass (27%), Idaho fescue (25%), bottlebrush squirreltail (23%) and Sandberg's bluegrass (12%). Within western juniper-low sagebrush-grass, the dominant grasses are Idaho fescue (63%) and bottlebrush squirreltail (34%). Within western juniper-mountain big sagebrush-grass, the dominant grasses are Thurber's needlegrass (56%), bottlebrush squirreltail (20%) and bluebunch wheatgrass (14%).

Plant communities without dominant shrubs or trees are grasslike sites and make up about 3% of the total area. Many of these communities are found in association with water and make up about 57% of the grasslike dominated sites. These are dominated by tufted hairgrass, Kentucky bluegrass, sedges and rushes. About 23% of the grasslike communities are dominated by crested wheatgrass and 17% by Nevada bluegrass.

Disturbances that have and are still influencing vegetation include livestock grazing, roads and suppression of wildfires. The biggest impact from livestock grazing was between about 1900 and 1935 before there was any control or management on the numbers or the season of use. There were areas of intense use from cattle and sheep during this period. The impact from wildfire suppression is also apparent as much of the present juniper is less than 100 years old and has been expanding in the absence of fire. Roads have contributed to the spread of noxious weeds and other undesirable plants.

C. Noxious Weeds

Noxious weeds such as Hoary cress (Cardaria draba), Canada thistle (Cirsium arvense), Bull thistle (Cirsuim vulgare), Diffuse knapweed (Cenaurea diffusa), Spotted knapweed (Cenaurea maculosa), Field bindweed (Convolvulus arvensis), Klamath weed (Hypericum perforatum), Mediterranean sage (Salvia aethiopis) and Yellow toadflax (Linaria vulgaris) have been identified in several areas.

D. Riparian Vegetation

Riparian vegetation buffers the fluvial system from potential impacts and disturbances caused by land management activities and natural events. A well vegetated zone of grasses, sedges, herbs, shrubs and trees characterize riparian areas. The above ground biomass provides coarseness to the surface and dissipates the energy of flowing water acting as a filter to catch and hold sediment before it reaches the stream. Below ground biomass (roots and woody structures) holds the soil mantle together and minimizes stream bank erosion into the channel.

Few examples of pristine riparian areas remain due mainly to past grazing practices. More than 75 years of intense grazing from domestic livestock have modified the riparian species composition. Cattle browse and trample shrubs and tree seedlings and reduce soil productivity through compaction and nutrient export. They can also contribute to bank sloughing and erosion. These can lead to channel downcutting and lowering of the water table. Lower water tables in riparian zones have changed the vegetative character and impaired floodplain functions. Willows and cottonwood diminish as the water table lowers. Soil that is no longer held in place by the vegetative system is subject to rapid erosion. The eroded material quickly contributes to the sediment load in the stream.

The forested lower elevations along the eastern flank of Crane Mountain have "stringers" of conifers in draws and swales where soil has collected or on some northern aspects where moisture can be retained for a slightly longer period during the growing season. These stringers can be very productive as riparian zones but only marginally productive for growing conifers.

Fire suppression has affected the vegetative component of the riparian zones by allowing encroachment of shade tolerant conifers into aspen and cottonwood. 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.

E. Sensitive Plants

Eight sensitive plant species are known to occur in the watershed. The Dismal Swamp area has been recommended for designation as a botanical special interest area.

Stream Channel

A. Fluvial System

Streams in the watershed include perennial, intermittent and ephemeral channels. Major streams and tributaries are listed below.

Table 2. Major Streams/Tributaries by Subshed

Subshed	Major Stream/ Tributary	Subshed	Major Stream/ Tributary
Mud Creek (01)	Mud Creek Porcupine Creek	Willow Creek (08)	Willow Creek Polander Creek
Lower Camas Cr. (02)	Camas Creek Squaw Butte Creek Rosa Creek	Cressler Creek (09)	Cressler Creek
		Big Valley (10)	Deep Creek
Horse Creek (03)	Horse Creek	Lower Deep Cr. (11)	Deep Creek
Burnt Creek (04)	Burnt Creek	Blue Creek (12)	Camas Creek Blue Creek
Crane Lake (05)	No perennial stream		

Subshed	Major Stream/ Tributary
Upper Deep Cr. (06)	Deep Creek North Fork Deep Cr . Middle Fork Deep Cr. South Fork Deep Cr . Mosquito Creek
Dismal Cr. (07)	Dismal Creek

Subshed	Major Stream/ Tributary
Peddlers Creek (13)	Parsnip Creek
Drake Creek (14)	Drake Creek Roaring Spring Fork
Gibson Canyon (15)	Deep Creek
Twentymile	Barley Camp Twelvemile N.F. Twelvemile Fifteenmile

Risk ratings for each subshed were developed based on roads, canopy and channel conditions. The ratings range from low to high risk. High road densities and high stream temperatures are the primary reasons for high risk ratings. Canopy removal from timber harvest did not result in a high risk rating.

Water Quality

The watershed provides water that supports many beneficial uses, including potable water for the Town of Lakeview, irrigation, livestock and wildlife watering, and road watering for dust abatement. Another beneficial use is fisheries habitat. The lower portions of the watershed are currently habitat for the threatened Warner sucker. The entire watershed provides habitat for redband trout (a Pacific Northwest Region sensitive species), brook trout and dace. Demand for these beneficial uses are expected to increase in the future. Private water rights exist within the watershed and specific information can be obtained from the Watermaster, District 12, Oregon Water Resources Department.

Stream temperature is the primary limiting factor that is out of compliance with State standards ($17.8^{o}C$, 7-day average). Thirteen streams are on the EPA 303(d) list for not meeting temperature standards. Only Dismal, Rosa and Twelvemile Creeks meet standards. Increased width to depth ratios in stream channels and reduced shading from loss of riparian vegetation are the primary causes of elevated temperatures. It is not known if State stream temperature standards can be achieved even under natural or reference conditions. In addition to stream temperature, Burnt Creek has biological criteria (macroinvertebrates) identified as a listing criteria.

Sieve analysis shows that fine sediment in spawning substrate ranges from four to 40%. Levels above 25 to 30% are considered detrimental to fisheries. Most stream segments monitored fall into the acceptable range. Eroding stream banks and sediment from roads and timber harvest are the primary sources of detrimental fine sediment in the stream substrate.

Heavy livestock grazing near the turn of the century resulted in riparian and stream channel degradation. Current livestock numbers are much reduced from historic levels and most stream channels are steadily improving under present management. Most stream channels have not returned to pregrazing conditions.

Species and Habitats

A. Terrestrial

1. Threatened, Endangered, and Sensitive Species

a) Northern Bald Eagle (Threatened)

Northern bald eagles occur in the winter, mainly in lower Deep Creek canyon near Adel. There is also significant use in Warner Valley along Crump Lake and private lands to the south. Eagles are also seen passing through the area between Goose Lake and Warner Basins. There are no known bald eagle nests or roost sites.

b) American Peregrine Falcon (Endangered)

Peregrine falcons have been observed within the watershed, probably from the hack/release site on Crump Lake to the northeast. Sightings have been recorded near Warner Canyon (1971), Walker Creek (1976), Peddlers Creek (1977) and Mud Creek (1978). There are no known active or historic nest sites. Potential habitat has been characterized at eight cliff sites.

Although the watershed contains potential habitat for peregrine falcons, a study conducted in 1982 by the Wilderness Research Institute (Boyce and White) concluded the habitat is marginal. The northern portion of Fish Creek Rim rated higher than the southern portion due to proximity to prey and nest aspect.

The study also concluded prey base for peregrines is inadequate above the rim (low numbers of small mammals and nongame birds). Therefore, they are completely dependent on sporadic migrations of neotropical birds, shorebirds and waterfowl found in the Warner Valley near the chain of lakes. It was concluded this would make it energetically too expensive to use the upper rim rock for a nest site. The lower rocks/cliffs on Fish Creek Rim would have the highest potential for occupancy.

c) Western Sage Grouse (BLM and FS Sensitive)

Western sage grouse occur year-round. Four strutting grounds have been located and six more have been observed within five miles. Sage grouse numbers appear to be stable or expanding slightly. There is no designated crucial sage grouse nesting or wintering habitat.

d) California Bighorn Sheep (BLM and FS Sensitive)

Forty to fifty California bighorn sheep occur along Fish Creek Rim. The Oregon Department of Fish and Wildlife (ODFW) has set a management goal of 100 bighorns. The bighorn sheep population is expanding and should approach ODFW's management goal sometime in the near future. There is no designated crucial California bighorn sheep habitat.

There are no other known threatened, endangered or sensitive terrestrial wildlife species that occur as residents or breeders.

2. Keystone Species

a) Big Game

The watershed lies within the 600,000-acre Warner Management Unit and is managed for mule deer, Rocky Mountain elk and pronghorn antelope. The area also contains huntable populations of cougar and black bear. All are permit or quota system hunts with the exception of the general eastern Oregon black bear season and the first season Rocky Mountain elk general hunt.

There are 25,000 acres of BLM-administered crucial deer winter range. Forested hiding cover ranges from a low of 0% in Big Valley and Gibson Canyon subsheds (nonforest habitat types) to a high of 65% in the Willow Creek subshed, with an overall average of 26%. Road densities within subsheds vary from a low of 0.4 mi/mi^2 in Upper Twelvemile to a high of 5.1 mi/mi^2 in Mud Creek. Average road density for the watershed is 2.4 mi/mi^2.

The current mule deer population is estimated at 2,475 animals which is 45% of the management objective of 5,500 animals. The population is managed for 15 bucks/100 does and 35 fawns/100 does. Mule deer numbers are expanding slightly and could reach the management objective in the future. Mule deer are present year-round, but no crucial fawning areas have been identified.

The expanding Warner Rocky Mountain elk herd is currently at 150 animals which is 30% of the management objective of 500 animals. The herd is managed for 20 bulls/100 cows and 40-50 calves/100 cows. There is no designated crucial calving or wintering habitat, however, elk are known to winter in the Sagehen Butte and Peddlers Creek areas extending south into California.

The pronghorn population is currently at 2,300 animals and provides hunting opportunities. Pronghorn numbers are static or decreasing slightly within the management unit due to weather and predation. Pronghorn can be seen year-round, but tend to migrate from the area during severe winters. There is no designated crucial pronghorn wintering or kidding areas.

Cougar numbers appear to be on the increase while black bear numbers are fairly stable.

b) Beaver

Beaver are present and expanding in numbers in all perennial drainages during good water years and attempt to colonize the lower reaches of intermittent drainages during high flow years. Beavers consistently colonize sections of Parsnip and Camas Creeks where habitat is sufficient to support them. The extent and actual locations of beaver occupation in the forested portion of the watershed is unknown. Historic records (1930s and 1940s) show native beaver populations along Camas, Deep and Dismal Creeks. Beavers were transplanted into eight different sites between 1937 and 1940.

c) Nongame Species

Other terrestrial animals common to the high desert are found in the area. Bobcats, coyotes, rabbits, porcupines, red-tailed hawks, golden eagles, prairie falcons, ravens, American kestrels, great-horned owls, amphibians, reptiles and other birds and small mammals are common. A large variety of nongame, neotropical birds and some cavity nesters are also found within the watershed.

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

a) General

Old-growth forest stands (Management Areas 14 and "Other" late/old forest cover) occur on 3,211 acres (5% of Forest Service acres). Old-growth forest cover has declined since the turn of the century, and species composition in pure ponderosa pine stands has changed to a mixed conifer dominated forest in some lower elevation areas. Late and old structure stands (LOS) occur on 30,084 acres, or 39% of the forested portion of the watershed. Interior habitat (areas buffered in 300 feet from a unit edge or a maintained road) occurs on 8,637 acres. Interior LOS patch size averages 22.5 acres.

There is no designated LOS forest cover on BLM-administered lands.

b) Goshawk

There is one known active goshawk nest site. Three historic nest sites have been recorded in the Cressler Creek subshed (1987). The extent or number of goshawk sightings is unknown. Suitable goshawk habitat exists in 11 of the 18 subsheds.

c) Pileated Woodpecker

There are no known active pileated woodpecker nests, however, a few pileated sightings have occurred throughout the area in the early 1980s. Suitable habitat exists in the mixed conifer LOS stands.

d) American Marten

There have been no marten sightings recorded or surveys conducted. Suitable habitat exists in some upper elevation mixed conifer and lodgepole pine LOS stands.

e) Black-backed/Three-toed Woodpecker

There have been no woodpecker sightings reported or surveys conducted. Suitable habitat exists in the mixed conifer and lodgepole LOS stands with adequate snag densities. Some potential habitat may exist on the forest fringe.

4. Dead Wood Habitat Management Indicator Species (MIS)

a) Primary Excavators

Snag and down log habitat is variable with some areas exceeding wildlife habitat needs and other areas devoid of dead wood. Actual numbers or densities for snags and down logs by subshed are not known. Similar potential habitat is located on the forest fringe.

5. Aspen/Deciduous Riparian Habitat MIS

a) Red-naped Sapsucker

There have been no sapsucker or neotropical bird surveys. Preferred habitat for this species (LOS aspen stands) has a limited distribution and encompasses about 4,000 acres within the watershed. Overall condition of aspen stands is unknown. Some potential sapsucker habitat may exist on the forest fringe and neotropical bird habitat in riparian areas and aspen stands.

B. Aquatic Habitat

Native redband trout and dace are found throughout the watershed. Nonnative brook trout are found in the upper reaches of some streams. The earliest records of brook trout stocking are from 1932. ODFW files indicate stocking of this species in Camas, Drake, Deep and Mud Creeks. Other nonnative fish include hatchery raised rainbow trout that had been stocked in the watershed. This activity last occurred in 1990 in Deep and Camas Creeks. Recent stocking occurred at 4 locations on Dismal Creek, 8 locations on Deep Creek and 4 locations on Willow Creek. Rainbow trout were stocked as early as 1925 in Camas Creek, and early stocking was done in all the major streams. It is not known if or how extensively planted stock have interbred with the native redband.

Brook trout were also observed in Willow Creek above 7,100 feet elevation by Fremont Forest biologists.

Redband trout up to 12 inches in length require access to spawning gravels of up to 2.5 cm in diameter with less than 25 to 30% fine sediment. Throughout the watershed, sediments are found that exceed the recommended threshold of 25 to 30% fines in spawning substrates.

Generally, water temperatures in excess of 21^{o}C (70^{o}F) are unfavorable and may cause stress to all age classes (Sigler and Sigler 1987). Temperatures in excess of 25^{o}C and 29.4^{o}C have been shown to be lethal (Bjornn and Reiser 1991). Temperatures of about 15^{o}C, or 58-60^{o}F, are ideal for optimal growth of rainbow trout (Leitritz and Lewis 1980). In many cases, stream temperatures exceed the recommended biological thresholds that are shown above.

Spring spawning trout will use intermittent streams for reproduction. Road culverts in intermittent streams are barriers to migration and a limiting factor for spawning on many intermittent streams.

Many streams have lost pool habitat through loss of large woody material and pools filling with sediment.

Downcutting of stream channels has occurred in some areas. Excessive herbivory by livestock and other ungulates in the late 1800s and early 1900s resulted in conditions that allowed downcutting of stream channels. Other factors leading to downcutting include road and ditch construction. Downcutting has contributed to lower water tables and decreased base flows. This is most evident in Camas Creek along Oregon State Highway 140 and in Deep Creek around Sagehen Butte. Downcutting has resulted in altered streamside riparian vegetation which provides less shade.

Overall, temperature, low flows and sediment appear to be the dominant limiting factors for fisheries.

Human Uses

Deep Creek and other subsheds have provided a multifaceted natural environment that is attractive to and utilized by human beings for all manner of activities. These activities range from utilitarian functions to spiritual pursuits and mental renewal. All the natural features that support a full array of human needs are contained within the watershed.

Occupation first occurred in the open areas contiguous and away from the dense forests. American Indian people took advantage of the dominant natural features, i.e. rock outcrops, wet and dry meadows, pooled and running water, for their resource needs and religious practices.

Occupation of the region is known to span a time period covering the last 10,000 years.

Historically, the area was utilized and occupied by members of the Fort Bidwell Band of the Northern Paiute Indians. Oral history of the Northern Paiute indicates that they drove the Klamath Indians out of the area. Given this, there is some possibility that formerly, the area was within the range of the Klamath.

Early settlers and explorers focused their activities and settlement in the open areas near the many springs, streams and other water sources. The trappers and mountain men moved through the Deep Creek watershed taking furbearing animals. The abundant water and grasses were very attractive to early pioneers and they brought livestock to these rich resource areas. Permanent Euroamerican settlement was located downstream away from the forest areas in the large open meadow/valley features (Big Valley) and further downstream in the nonforested grasslands.

A military post, Camp Warner, was established to protect settlers who began to occupy what had formerly been lands open to the American Indian people. There are actually two Camp Warner locations. The first camp was located on Hart Mountain to the east of the watershed. After one year, it was moved to a location west of Warner Valley. This new location is located on private property.

One historic road, the Oregon Central Military Road, crosses the area. This road was used sporadically for the movement of supplies for the army.

Historically, the area was used for ranching and livestock grazing. Numerous small water developments or range improvements dot the landscape. Reservoirs and spring developments provide livestock water.

There are 20 grazing allotments within the watershed: Blue Creek, Vinyard Individual, Hickey Individual, Lane Plan II and Sagehen on BLM-administered public land and Barley Camp, Crane/Kelly, Crane Mountain, Horse Prairie, Little Cove, McDowell, Porcupine, Rogger Peak and Squaw Butte on National Forest System lands. Portions of six other BLM grazing allotments are in the watershed: Flynn, Fitzgerald, Lynch-Flynn, Crump Individual, Lane Plan I and Schadler. All the allotments encompass both private and public land.

All 11 BLM allotments had biological assessments completed in 1994 to determine the effect of livestock grazing management on the threatened Warner sucker. Livestock grazing management in most of the allotments has been determined to have "No Effect" on the sucker. Other allotments have had management adjusted so the determination is "May affect, not likely to adversely affect".

Timber harvesting and supportive infrastructure (i.e. roads) construction began slowly, then accelerated rapidly after 1945.

Adjacent to the watershed boundary, the Crane Mountain roadless area provides a unique recreation experience for the forest user.

STEP 2. IDENTIFICATION OF ISSUES AND KEY QUESTIONS

Step 2 identifies the key issues and questions developed by the core team. This identification of issues helps focus the analysis on the key elements of the ecosystem that are most relevant to the management questions and objectives, human values or resource conditions within the watershed. Each issue is addressed in the analysis by specifically answering the key questions using the parameters listed.

Issue #1: Past management practices such as logging, grazing and road building have altered water quality within the watershed.

Key questions:

1. Does Deep Creek and its associated tributaries meet State of Oregon water quality standards?

   Parameters: Temperature.

2. Where and which management activities and natural processes have resulted in degraded water quality within the watershed?

   Parameters: Bank stability, percent stream shading, sediment delivery, macroinvertebrates and erosion.

3. What recommendations can be made in this document to implement a Water Quality Management Plan for the Deep Creek watershed?

   Parameters: Follow Oregon Department of Environmental Quality's Guidance For Developing Water Quality Management Plans That Will Function As TMDLS For Non-point Sources, April 15, 1997.

4. Are special management recommendations necessary above the water collection system for the Town of Lakeview?

   Parameters: Biological contaminants and physical disturbances that may affect water quality.

Issue #2: Functions and physical characteristics of the riparian ecosystem within the watershed have been altered from their historic condition.

Key questions:

1. How have land management activities and alteration of natural disturbance processes affected riparian ecosystems? Are these activities preventing recovery where these ecosystems are currently not functioning properly?

Parameters: Range standards including PFC (Proper Functioning Condition), utilization and suitability. Other factors include bank stability, channel morphology, soil condition, soil drainage/lowering of the water table, large woody debris and vegetative community.

2. How have changes in riparian ecosystems affected other resources such as riparian vegetation, fish and wildlife habitat, forage productivity and downstream irrigation?

Parameters: Pools, temperature, stream flows, water quality (temperature and sediment), plant composition and seral stage.

Issue #3: Past management practices such as road construction, irrigation, grazing, timber harvest, etc., have altered base flow, peak flow and timing of peak flow.

Key questions:

1. Has the natural flow regime and water available for irrigation (water rights) been altered by grazing, timber management, road building and diversion activities?

Parameters: Timing and frequency of mean flows and base flow, cumulative watershed effects, soil moisture storage, soil drainage and current disturbances.

2. How have management activities and alteration of disturbance processes affected the watershed's ability to withstand catastrophic events?

Parameters: Stream channel morphology and volume of runoff.

3. How and where have channel diversions and impoundments affected the flow regime of the Deep Creek subshed?

Parameters: Timing and frequency of mean and peak flows and stream channel morphology.

Issue #4: Management activities have modified fish and wildlife habitat conditions and have caused changes in species distribution and populations.

Key questions:

1. How have fish and wildlife abundance, distribution, diversity, habitat conditions and aquatic system processes and flows been altered?

Parameters: Past and present habitat potential, suitability, security and conditions; fish and wildlife species composition, distribution and populations; and instream barriers, large woody debris, pool habitat, bank stability, streamside cover and substrata composition, bank width to depth ratios.

2. How have management activities affected fragmentation of fish and wildlife habitat and populations which threaten species viability?

Parameters: Core late/old seral forest habitat, edge/patch and matrix habitat, cover/forage habitat, nesting/fawning/rearing habitat, security habitat, dead wood habitat, and fish and wildlife species distribution and populations and location of key refugia or hotspot habitat for threatened, endangered and sensitive species (TES), keystone and MIS species and habitat connectivity.

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

Parameters: Location and timing of management activities and natural disturbance events affecting fish and wildlife habitat abundance, condition, distribution and diversity.

Issue #5: Past management activities and alteration of natural disturbance processes, including fire exclusion, have changed the function, pattern, composition, structure and the density of vegetation within the watershed.

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, noxious weeds), size, age structure and density.

2. What caused the changes in the landscape patterns of plant communities and seral stages?

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.

3. How have management activities and alteration of disturbance processes affected the watershed's ability to withstand catastrophic events?

Parameters: Historic vs. current mortality, disease and insects and fire occurrence, frequency and intensity.

4. 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.

5. To what extent have native plant species expanded, been replaced by exotics, and what strategies can be used to slow or prevent the spread of exotics and restore native species?

Parameters: Extent and location of nonnative plants, replacement of native grass species with nonnative grass species, status of cottonwoods.

Issue #6: Meet peoples' needs for uses, values, products and services within the limitations of maintaining ecosystem health, diversity and productivity both now and in the future.

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, cultural plant abundance and distribution.

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

   Parameters: Open road density for public access, fire, control livestock grazing and logging systems needs, road closures and obliteration, accelerated erosion and stream sediment, fish and wildlife habitat suitability and species productivity.

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

   Parameters: Logging and road systems, soil compaction and erosion, water quality, fish and wildlife habitat suitability and species productivity, wood products availability.

STEP 3. DESCRIPTION OF CURRENT CONDITIONS

Step 3 deals with the current range, distribution and condition of the relevant ecosystem elements within the watershed. It documents the more detailed analyses completed for the core topics and other ecosystem elements identified in the characterization of the watershed and issues and key questions. Current condition refers to the time period from about 1945 to present.

Erosion Processes

Erosion means the wearing away of the land surface by detachment and movement of soil and rock fragments through the action of moving water or wind and by gravity. Once this material moves from its position in the landscape it is considered to have eroded. Much of this material is deposited along the way where it becomes part of the soil mantle.

The current erosional condition of the watershed reflects management influences which began in the late 1800s with the introduction of logging, road building and grazing from large herds of sheep. By 1950, a national market had developed for lumber and logging increased significantly. All of these activities have resulted in cumulative effects to the soil over time with a resultant increase in accelerated erosion rates. These activities often change the amount of organic matter covering the soil, the physical properties of the soil, the infiltration and percolation of water, and consequently the amount of water that flows over the land surface. The effects of wildfires on soil erosion have diminished over time and are assumed to have returned to natural levels. Most erosion effects due to grazing occur within riparian zones with minimal levels occurring on the uplands.

Road building and logging have generally had the greatest effect on increasing upland erosion rates over natural levels. A model for management-induced surface erosion was developed for timber harvest and road activities using the Guide for Predicting Sediment Yields From Forested Watersheds (1981). Erosion rates should be considered as indicative of relationships with the various activities rather than as absolutes because of the many interrelated variables that influence the erosion process. No soil loss rate monitoring data is available.

This model is based on research data that suggests a basic soil loss rate associated with roads, fire and logging, which are reduced as a function of time since the activity took place. The erosion rates in the model are modified by the dominant controlling variables on the land unit on which they occur, the magnitude of the activity, specific characteristics of the activity, and possible mitigation factors. Geologic erosion factors are used as coefficients to modify basic erosion rates. Basalt igneous rock types have a geologic erosion factor of 0.42 and acid igneous (granitic/rhyolitic) have a geologic erosion factor of 1.0. Therefore, the assumption is that basalt derived material is 42% as erosive as rhyolite material. Most of the soils in the watershed are basalt derived with small portions of the headwaters of Big Lake, Peddlers Creek, Drake Creek, Mud Creek, Upper Deep Creek and Dismal Creek subsheds having rhyolite as parent material. The geologic factors in the following models are based on weighted averages of the different geologic parent materials.

Table 3 shows estimated current erosion rates for roads.

Table 3. Estimated Erosion Relating to Roads (tons/yr)*

Subshed	Total Road Mi	Total Road Ac	Basic Erosion Rate	Geologic Er Factor	Mitigation % Reduction	Erosion Rate (tons)
Mud Cr. (01)	112	244	5,000 t/sqmi	.68	45%	713
Lwr. Camas (02)	97	211	5,000 t/sqmi	.83	45%	753
Horse Cr. (03)	48	104	5,000 t/sqmi	.44	45%	197
Burnt Cr. (04)	58	126	5,000 t/sqmi	.60	45%	325
Crane Lake (05)	41	89	5,000 t/sqmi	.59	45%	226
Upper Deep (06)	23	50	5,000 t/sqmi	.65	45%	140
Dismal Cr. (07)	29	63	5,000 t/sqmi	.46	45%	125
Willow Cr. (08)	70	152	5,000 t/sqmi	.55	45%	359
Cressler Cr. (09)	23	50	5,000 t/sqmi	.68	45%	146
Big Valley (10)	4	9	5,000 t/sqmi	.86	45%	33
Lower Deep (11)	12	26	5,000 t/sqmi	.56	45%	63
Blue Cr. (12)	24	52	5,000 t/sqmi	.57	45%	127
Peddlers Cr. (13)	20	44	5,000 t/sqmi	.50	45%	95
Drake Creek (14)	75	163	5,000 t/sqmi	.54	45%	378
Gibson Canyon (15)	28	61	5,000 t/sqmi	.48	45%	126
Upper Twelvemile (101)	1	2	5,000 t/sqmi	.42	45%	4
Fifteenmile (103)	11	24	5,000 t/sqmi	.42	45%	43
Twentymile (104)	~		5,000 t/sqmi	.42	45%	~

Estimated Total: 3,853 t/yr

* The road area includes the distance from the toe of the fill slope to the top of the cutslope. This distance is estimated to be 18 feet on average. It includes all system roads and assumes roads are cross drained. The geologic erosion factor adjusts the basic erosion rate to reflect inherent soil loss rates for different geologic rock types. The basic erosion rate represents a stable value from 3 to 6+ years after initial construction. The mitigation % reduction further reduces erosion rates according to various mitigation measures.

Table 4 shows estimated current erosion rates for timber harvest.

Table 4. Estimated Erosion Relating to Timber Harvest (tons/yr)*

Subshed	Percent Impacted	Acres Impacted	Basic Erosion Rate	Geologic Er Factor	Erosion Rate (tons)
Mud Creek (01)	44	6,146	90 t/sqmi/yr	.68	588
Lower Camas Cr. (02)	5	1,115	90 t/sqmi/yr	.83	130
Horse Cr. (03)	10	1,925	90 t/sqmi/yr	.44	119
Burnt Creek (04)	39	3,304	90 t/sqmi/yr	.60	279
Crane Lake (05)	14	1,598	90 t/sqmi/yr	.59	133
Upper Deep Creek (06)	7	571	90 t/sqmi/yr	.65	52
Dismal Creek (07)	5	388	90 t/sqmi/yr	.46	25
Willow Creek (08)	34	3,019	90 t/sqmi/yr	.55	234
Cressler Creek (09)	10	544	90 t/sqmi/yr	.68	52
Big Valley (10)	0	0	90 t/sqmi/yr	.86	0

Subshed	Percent Impacted	Acres Impacted	Basic Erosion Rate	Geologic Er Factor	Erosion Rate (tons)
Lower Deep Creek (11)	2	156	90 t/sqmi/yr	.56	12
Blue Creek (12)	18	1,807	90 t/sqmi/yr	.57	145
Peddlers Creek (13)	7	510	90 t/sqmi/yr	.50	36
Drake Creek (14)	3	1,112	90 t/sqmi/yr	.54	84
Gibson Canyon (15)	0	0	90 t/sqmi/yr	.48	0
Upper Twelvemile (101)	0	0	90 t/sqmi/yr	.42	0
Fifteenmile (103)	10	276	90 t/sqmi/yr	.42	16
Twentymile (104)	~	~	90 t/sqmi/yr	.42	~

Estimated Total: 1,905 t/yr

* The logging system used for this evaluation was clearcutting with tractor yarding. Temporary roads, skid trails and landings are assumed to have been water-barred and seeded. Calculations assume high current disturbance areas have erosion rates equal to four years after the initial disturbance. This value is conservative and actual erosion rates are most likely lower.

The effects of current management activities on soil productivity was evaluated to determine the extent of all lands in an adverse condition. Adverse conditions are detrimental effects on the soil resource (Land and Resource Management Plan for the Fremont National Forest, page 80). The analysis evaluated all system roads, landings, spur roads and skid trails as well as lands detrimentally compacted, puddled, displaced or eroded. All subsheds within the watershed were mapped as follows: none - no adverse impacts; light - adverse soil impacts occur on less than 10% of the area; moderate - adverse soil impacts occur on 10 - 20% of the area; and high - adverse soil impacts occur on more than 20% of the area.

Table 5 shows the estimated percent of each watershed in the none/slight/moderate/high category.

Table 5. Estimated Current Disturbances of Subsheds (%)

Subshed	High	Moderate	Light or Not Related
Mud Creek (01)	44	19	37
Lower Camas Cr. (02)	5	28	67
Horse Cr. (03)	10	21	69
Burnt Creek (04)	39	21	40
Crane Lake (05)	14	2	84
Upper Deep Creek (06)	7	4	89
Dismal Creek (07)	5	1	94
Willow Creek (08)	34	24	42
Cressler Creek (09)	10	3	87
Big Valley (10)	0	0	100
Lower Deep Creek (11)	2	0	98
Blue Creek (12)	18	0	82
Peddlers Creek (13)	7	0	93
Drake Creek (14)	3	0	97

Subshed	High	Moderate	Light or Not Related
Gibson Canyon (15)	0	0	100
Upper Twelvemile (101)	0	0	100
Fifteenmile (103)	10	0	90
Twentymile (104)	~	~	~

~ - Not available

More specifically, Willow Hawk timber sale harvest unit #2 was intensively monitored to determine overall soil impacts. Total adverse impacts were 40%. This is consistent with other timber sale harvest units monitored on the Fremont National Forest (Thomas Creek W. A., Dairy/Elder and South Creek W. A. and Silver Creek W. A.). Generally, adverse impacts increase on flat slopes where tractor logging has occurred. Conversely, they decrease on steeper slopes where less tractor logging has occurred. Monitoring has shown that soil compaction is the largest adverse impact, with displacement and puddling being only a small part of total impacts.

Current conditions of mass movement are not a high concern within most of the subsheds. However, 281 acres of landslide deposits are identified on the GIS geology coverage in the Upper Deep Creek subshed. Evidence of historic landslides indicates that this area is susceptible to further mass failure. The potential also exists for debris avalanches to occur on steeper slopes on rhyolitic eruptive centers. Portions of the headwater area of Big Lake, Peddlers Creek, Drake Creek, Mud Creek, Upper Deep Creek and Dismal Creek subsheds have parent material consisting of rhyolite flows which are at risk of debris avalanches on steeper slope areas. Road building and logging significantly increase the risk for either type of mass movement within both the historic landslide area and the rhyolite flow areas.

Once eroded soil or rock particles reach a stream channel, it is considered sediment. Although sediment is dependent on the degree of erosion, these parameters are not the same. It is estimated that at least 10 to 20% of the total erosion becomes sediment in current conditions. The amount of sediment generated by project activities is largely dependent on the position of a project in the watershed. Projects located in the upper portions of the watershed generally produce less sediment than projects in the lower areas. Also, most sediment can be mitigated by providing adequately spaced drainage structures and buffers between the project site and the stream course. Field observations by Mike Montgomery show that many cross drainage structures (waterbars and dips) do not meet spacing recommended in the Guide to Erosion Control on Forest Roads and Trails (1973) and that many roads are located within Riparian Habitat Conservation Areas (RHCAs). Lack of cross drainage and riparian buffers is resulting in sediment in the stream channel.

Hydrology

Continuous flows have been recorded at three U.S. Geological Survey (USGS)/State operated gauging stations: 1) Deep Creek above Adel (1931-1991), 2) Drake Creek (1948-1973) and 3) Twentymile Creek near Adel (1941-1991). Also, spot flows were recorded for streams during the Level II stream inventory. Current conditions of base flow, mean flow, peak flow and hydrologic conditions associated with roads, compacted soil and canopy removal are discussed below. Flows are available for Camas Creek, but were not used in this analysis.

A. Base Flow

Base flows occur during late summer and early autumn (August, September, October and November). These are the minimum streamflows that naturally occur from a combination of factors including low precipitation, reduced drainage from the soil and bedrock and sustained high evapotranspiration. Base flows are important for maintaining aquatic and riparian habitat, water for irrigation and for maintaining wildlife and livestock watering sources.

High elevation streams are very stable and have water tables near the surface. Base flows in the upper watershed are not affected by downcutting. Lower elevation streams in alluvial depositional areas have lower water tables in current conditions than in reference conditions. This has occurred through channel downcutting and loss of beaver habitat. Base flows are most likely lower below these riparian areas. The magnitude of this change is unknown.

Meadow areas have been dried by channel downcutting and channel construction by man. Many streams in the lower elevations have wide alluvial depositional areas (meadows) that are downcut and have lost their wide riparian component. Big Valley was most likely a large wet meadow area in reference conditions. The historic conditions are unknown, but it is assumed that the area had a very high water table with large expanses of willow and beaver populations. Presently, the area has been channelized and uses water from Deep Creek for irrigation. Further information about current conditions of Big Valley is unknown. Water rights information can be obtained from the Watermaster, District 12, Oregon Water Resources Department. In summary, channelization by man and stream channel downcutting has resulted in a lowering of the water table that provides less flow in late season below the historic wet meadow areas. The magnitude of this change is unknown.

The volume of base flow varies depending upon location in the watershed. The gauging sites higher in the watershed show substantially larger flows per square mile than gauging sites at lower elevations. Table 6 shows the base flow per square mile for gauged/recorded streams.

Table 6. Base Flows For Select Streams

Major Stream/Tributary	Base Flow (CFS)	Base Flow/ Mi^2	CFS/Mi^2	Date
USGS Gauging Stations				
Deep Creek above Adel	4.3	249	.01	9/4/81
Twentymile Creek near Adel	2.3	194	.01	9/4/81
Drake Creek (mouth)	5.8	67	.09	9/4/81
Camas Creek		Data Gap		
Spot Flow Records				
Deep Creek (near FS boundary)	1.9	13.5	.14	9/4/81
Dismal Creek (mouth)	1.3	10.0	.13	9/4/81
Willow Creek (near FS boundary)	1	8.5	.12	9/1/82

B. Mean Flow

Average daily flows are available at the three gauging sites identified above. The mean of these are shown in Table 7 for each month for the last 15 years.

Table 7. Mean Daily Flow
Last 15 Years of Record

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Deep Creek	25	44	78	66	112	200	333	420	200	37	14	18
Twentymile Cr.	5	11	25	36	127	164	102	96	46	10	4	4
Drake Creek	7	7	7	24	29	40	23	17	10	7	7	7

Note: Calculations in the following sections use data for years of average precipitation. This was determined using plus or minus one standard deviation of the mean precipitation as measured in Lakeview, Oregon (9.9-18.3 inches).

Further evaluation of the mean flows show that the volume of water produced per inch of precipitation varies greatly from one watershed to another. The results of this analysis are shown in Table 8 for average precipitation years (9.9 to 18.3 inches) measured in Lakeview, Oregon.

Table 8. Average Acre Feet Per Inch Precipitation

Stream	Average Years	Total Volume of Water for the Year (Acre Feet)	Acre Feet Water Per inch Precip
Deep Creek	1930-1945	76,195	5,366
	1941-1960	93,257	6,504
	1975-1991	83,808	6,208
Twentymile Cr.	1941-1960	38,321	2,589
	1975-1991	36,383	2,618
Drake Creek	1951-1973	10,395	654
Camas Creek		(Data Gap)	

Mean flows were compared for Deep and Twentymile Creeks for years with average precipitation. This comparison showed no statistical change in monthly mean flows (less than plus or minus one standard deviation), when comparing early with later years of record. This is further verified by Table 8 which shows only slight changes in volume of water produced for the different time periods.

Timber harvest can influence the flow regime by increasing total flow, altering peak discharge rate and changing the duration of flows. These changes in energy and sediment transporting capability can cause an alteration in both channel morphology and aquatic habitat. A study by Troendle and Olsen (1991) of the Fool Creek Drainage at the Fraser Experimental Forest in Colorado showed a large increase in duration of flows in the range of 80 to 120% of bankfull as a result of timber harvest. Figure 1 shows similar results for the Deep Creek watershed when comparing the periods 1933-1960 and 1961-1991. The 1-1/2 year return interval event was used as a surrogate for bankfull and nearly doubled in duration in current conditions.

C. Peak Flow

The data from the Deep Creek gauging station shows that annual peak discharge is dominated by spring snowmelt runoff with most peaks in daily hydrographs occurring in May (peaks occurred in March in Twentymile and Drake Creeks). However, the highest instantaneous peak flows occur as a result of rain on snow events in December and January.

The USGS statistical summaries show that the 100 year event for the gauge at Deep Creek (above Adel) is 8,800 c.f.s. This flow was exceeded in 1964 with 9,420 c.f.s. measured. A Log Pearson Type III analysis was developed to compare peak flows versus recurrence intervals for the periods: 1970 to present, 1946 to 1969 and 1927-present. Figure 2 shows that peak flows for the return interval of 2 to 50 years are higher for the period 1970-present than they were for the period 1923-1997. This indicates that peak flows are increasing in size. This change was not evident at the 100 year return period.

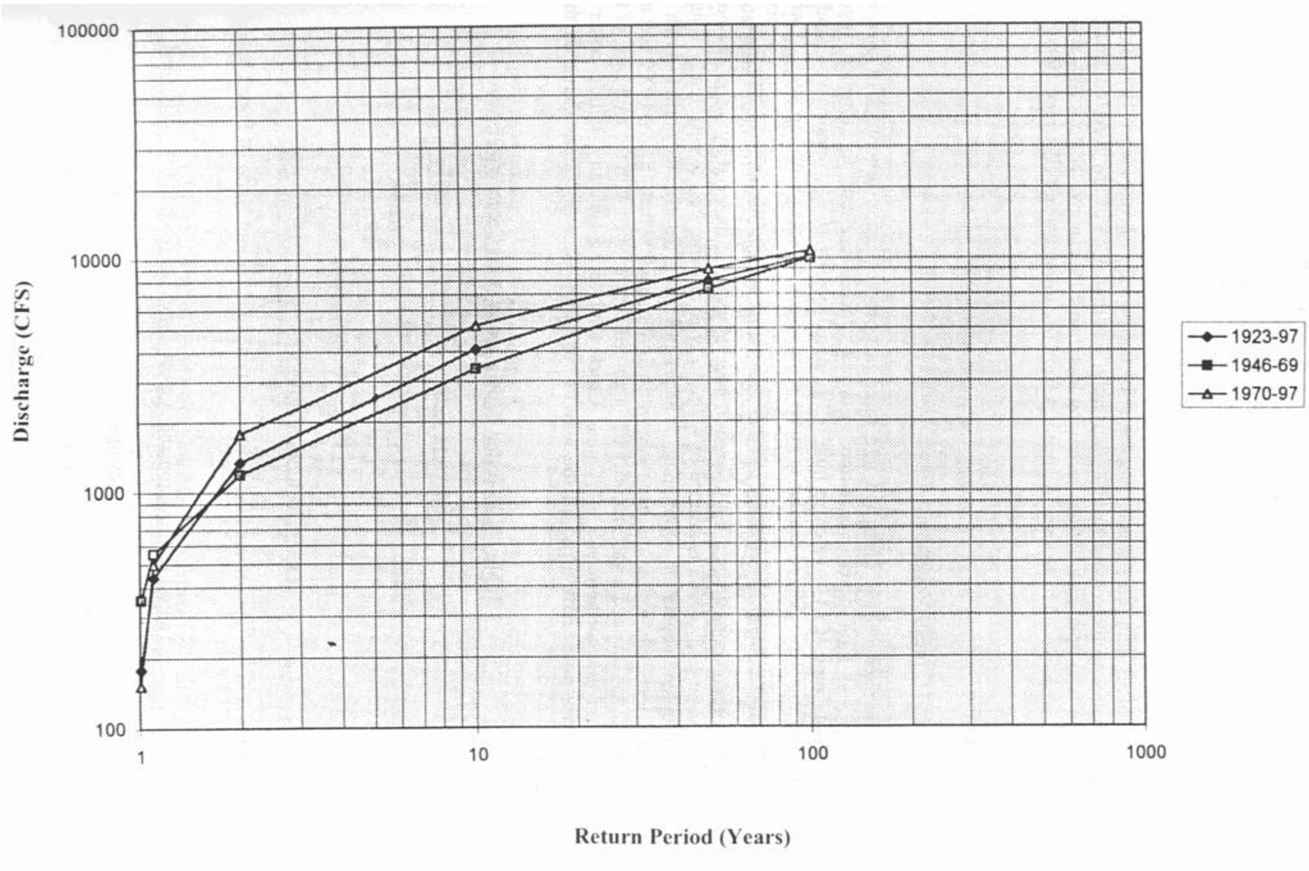
Peak flows have the potential to be higher with increased drainage efficiency from roads. Wemple (1994) focused on the hydrologic interaction of forested roads with stream networks. Wemple found nearly 60% of the road network drained to streams and gullies, and are, therefore, hydrologically integrated with the stream network. The 60% figure from Wemples study was used to estimate new drainage densities for this watershed. Closed roads are considered to contribute to the overall drainage efficiency and are therefore included in Table 9.

Table 9. Overall Drainage Density
(Drainage Density on Combined National Forest System and Private Lands)

Subshed	*Stream Drainage Density (Mi/Mi^2)	Road Density (Mi/Mi^2)	Total Estimated Density (Mi/Mi^2)	Increase in Drainage Network
Mud Creek (01)	1.9	5.1	5.0	160%
Lower Camas Cr. (02)	2.0	2.9	3.8	90%
Horse Cr. (03)	1.6	2.5	3.1	90%
Burnt Creek (04)	1.5	4.4	4.1	170%
Crane Lake (05)	1.4	2.3	2.8	100%
Upper Deep Cr. (06)	2.6	1.7	3.6	40%
Dismal Creek (07)	2.5	2.4	3.9	60%
Willow Creek (08)	2.0	5.1	5.0	150%
Cressler Creek (09)	2.4	2.7	4.0	70%
Big Valley (10)	2.5	0.5	2.8	10%
Lower Deep Cr. (11)	1.7	1.1	2.4	40%
Blue Creek (12)	1.9	1.6	2.8	50%
Peddlers Creek (13)	1.5	1.7	2.5	70%
Drake Creek (14)	~	1.3	~	~
Gibson Canyon (15)	~	1.29	~	~
Upper Twelvemile (101)	1.7	0.4	1.9	12%
Fifteenmile (103)	1.8	2.5	3.3	80%
Twentymile (104)	~	~	~	~

*Stream drainage densities include perennial, intermittent and ephemeral streams.

FIGURE 2
Deep Creek



Canopy removal is also a factor in increased flows. Research indicates that when 20 to 30% of a watershed is in a cut over condition, measurable changes in stream flow can be detected (Troendle 1982). The amount of change depends largely on the vegetation type, intensity of harvest or disturbance and the climatic and physiographic conditions.

Canopy cover on a landscape basis was determined using 1991 ISAT imagery (Table 12). Comparison of this canopy with reference canopy shows that there is more canopy now in forested areas than there was during the reference period. Changes since 1991 have not made a large change to the overall results. Currently, less than 12% of any forested area in a cut over condition is in openings, defined as having less than 20% canopy. Historically, about 8% of the forested areas would have been in openings from fire/insect/disease (Petersen 1998).

Vegetation

A. Upland (Forest) Vegetation

The watershed can be classified into three distinct vegetation groupings of upland forested, riparian and high desert vegetation. Current ecoclassifications for forested vegetation are lodgepole pine (CL), ponderosa pine (CP), mixed conifer (CW), juniper woodlands (CJ) and other (Table 10). Mixed conifer is either a true white fir species or a mixture of white fir and ponderosa pine. The eastern flank of Crane Mountain below 6,500 feet is now a mixed conifer site (Table 11). It was most likely maintained as a more open ponderosa pine association prior to the twentieth century when the fire return interval was uninfluenced by man. The northern part of the watershed, which is drained by Camas Creek running west to east, tends to function as a typical upland vegetation community. It has slopes that generally face north to south. The north slopes are slightly wetter and have true white fir above 6,000 feet. Below 6,000 feet in elevation white fir has invaded a vast majority of the mixed conifer sites with the exclusion of fire. South slopes on the northern side of Camas Creek tend to be typically a little hotter and drier. Ponderosa pine tends to go all the way to the valley floor of Camas Creek on the southern aspects.

Table 10. Forested Ecoclasses in Deep Creek Watershed

Ecoclass Type	Acres*
CL	6,634.10
CW	29,188.11
CP	6,786.97
CJ	4,311.23
Other (Includes nonforest)	18,714.49

*does not include private land or lands outside the Fremont National Forest boundary.

Table 11. Elevation and Aspect Zones for Deep Creek Watershed

Elevation	Acres
4,501-5,000	1
5,001-5,500	3,456

Elevation		Acres
5,501-6,000		67,857
6,001-6,500		42,749
6,501-7,000		23,081
7,000+		14,000
	Total	151,234

Aspect		Acres
Flat		7,736
N		31,642
S		31,724
E		51,822
W		28,304
	Total	151,228

Ponderosa pine with multi-sized understories is dominated with large pine, a mixture of small patches of ponderosa pine regeneration and patches of intermediate size classes. Many of the ponderosa pine sites have been repeatedly entered over the last forty years and have a diminished large tree component. The drier sites have western juniper coming in from the edges as a response to fire exclusion.

Most of the forested stands fall in the category of <25% canopy cover (18%) or 26-55% canopy cover (29%). The large percentage in the 26 to 55% group reflects the increased stand density due to fire suppression during the twentieth century (Table 12).

Table 12. Canopy Cover (Current Condition)*

Cover Class	Acres	% of Watershed Area
Nonforest	16,850	11
Shrubs	57,693	38
< 25%	27,364	18
26 - 55%	43,547	29
56 - 70%	4,796	3
71%	393	<1

*Data taken from Fremont National Forest ISAT.

Current stand density is higher than the historical level in most of the watershed. White fir and mixed conifer stands have high densities that place them at risk to disease, insect attack and density-related mortality.

Mixed conifer that had a large component of ponderosa pine has been entered several times to remove the high value large trees. This practice of "high grading" has left many stands with a large stagnant component of white fir that normally would have been absent in many stands historically. Several of these stands were placed on a management track called delayed regeneration. This prescription was designed to quickly increase the growth of residual thinned white fir to a fourteen inch average stand diameter and regenerate the stand to ponderosa pine.

The process delayed stand regeneration and conversion to ponderosa pine by about forty years. The intent was to capture the growth of residual white fir while providing a commercial product within the Lakeview Federal Sustained Yield Unit.

Juniper woodlands have increased in the current condition due to the change in the fire regimen along with potential climate change. Juniper has invaded the drier sites of the desert edges and also has become more prevalent in the "stringers" common along the southeastern portion of the watershed. Juniper also occurs as a common understory species in at least 1,500 acres of ponderosa pine forest.

Stringers are the forested portion of the landscape that is usually associated with shallow depressions, riparian zones or areas that may collect slightly more soil than the majority of the dry desert landscape. They are areas of slightly higher moisture holding capacity that make it possible to support trees. The stringers are usually ecotones between the riparian zone and the open desert fringe. Many of these stringers on the forested portion in the southern half of the watershed have been entered to remove large ponderosa pine. The environment in these stringers has been changed by entry and resulted in areas that may be marginally stocked compared to historical conditions.

The grass/shrub component has changed with the change of disturbance regimens. Fire exclusion along with drier climatic conditions on the desert fringe has caused a change from herb dominated communities to communities that are dominated by ponderosa pine where moisture will allow it to gain a foothold or western juniper on drier sites. The expansion of juniper woodlands covers a significant area. In many cases there are few herbaceous plants or shrubs in the juniper woodlands because of a noteworthy increase in juniper density and distribution. A similar condition has occurred in some white fir where trees have not been removed or kept in check by frequent fires. The white fir has out competed the understory shrub, herb and grass layer for available light and moisture leaving little vegetation at ground level.

In many areas not capable of supporting tree growth, former herb and native grass dominated communities are now supporting dense stands of shrubs such as big sagebrush and rabbitbrush. Grazing has removed many of the fine grass fuels which limits the potential for fire to carry. Fire now generally requires much drier conditions to start and carry. When they occur, the intensity and severity is greater and substantial change to much of the native understory of perennial grasses or herbs is more likely.

1. Late and Old Forest Structure Assessment

This assessment is based on the definition of late and old structure (LOS) by W. E. Hopkins, Area 4 ecologist for the Deschutes, Fremont, Ochoco and Winema National Forests. LOS describes a timber stand's ability to meet a characterization of attributes that are necessary for certain wildlife species habitat. This is not the classical definition of structure which deals with tree size and canopy layers. Seral stage defines the points in time where a stand passes defined levels of development. It is ecological plant succession in an orderly, slow progression of change in plant community composition in a stand from initial colonization to the attainment of climax vegetation typical of a geographic area (Hopkins et al. 1992).

Definitions of seral stage by Hopkins et al. are lengthy and can be viewed in his publications available at the Fremont National Forest Supervisor's Office. Structural stages (Table 13) are defined as stand initiation, stem exclusion, understory reinitiation and old growth by Oliver and

Larson (1990). They are repeated here for clarity in documenting the current condition of the watershed.

> Stand Initiation Stage. After a disturbance, new individuals and species continue to appear for several years.
>
> Stem Exclusion Stage. After several years, new individuals do not appear and some of the existing ones die. The surviving ones grow larger and express differences in height and diameter, first one species and then another may appear to dominate the stand.
>
> Understory Reinitiation Stage. Later, forest floor herbs and shrubs and advance regeneration again appear and survive in the understory, although they grow very little.
>
> Old Growth Stage. Much later, overstory trees die in an irregular fashion, and some of the understory trees begin growing to the overstory.

Table 13. Stand Structure

Stage	Acres	Percent of Forested Acres in the Watershed (76,459 acres)
Stand Initiation (Early Single Strata)	4,514	5.90
Understory Reinitiation (Early Multi Strata)	0	0.00
Stem Exclusion (Mid Open Canopy)	8	<0.01
Stem Exclusion (Mid Closed Canopy)		<0.01
MC-20 (Canopy Cover = 41 - 55%)	12	<0.01
MC-23 (Canopy Cover = 56 - 70%)	25	<0.01
MC-24 (Canopy Cover = 70+%)	3	<0.01
Understory Reinitiation (Multi-strata w/o Lg Trees)		
MM-20 (Canopy Cover = 41 - 55%)	66,772	87.33
MM-23 (Canopy Cover = 56 - 70%)	4,734	6.19
MM-24 (Canopy Cover = 70+%)	369	0.44
Understory Reinitiation (Multi-strata with Lg Trees)		
LM-20 (Canopy Cover = 41 - 55%)	0	0.00
LM-23 (Canopy Cover = 56 - 70%	0	0.00
LM-24 (Canopy Cover = 70+%)	22	<0.01
Understory Reinitiation (Single-strata with Lg Trees)	0	0.00

According to this analysis, there are 22 acres that meet the Hopkins definition of LOS utilizing the data presented in the Fremont National Forest GIS ISAT coverage.

2. Productivity

Condition classes are found in Table 14 and refer to a productivity rating defined in the Forest plan. Associated species are the mixed conifer acres, pine species refers to ponderosa pine and lodgepole refers to lodgepole pine. Refer to the Forest plan for more information. These data were used to provide information on commodity output for the Forest plan.

Table 14. Condition Class for Deep Creek Watershed

Condition	Acres
AH (associated species high productivity)	30,042
AL (associated species low productivity)	422
PH (pine high productivity)	1,738
PL (pine low productivity)	5,245
LH (lodgepole high productivity)	509
LL (lodgepole low productivity)	1,235
O (other)	23,884
PS (pine special)	103
Total	63,178

Current timber production potential is characterized in Table 15 by plant associations.

Table 15. Timber Production Potential

Ecoclass	Average Growth (cu ft/ac/yr)	Range (cu ft/ac/yr)	5%CI	Acres
CL-C1-11	29	20-38	9	0
CL-C1-12	20	13-27	7	2,309.13
CL-G3-15	54	44-64	10	237.13
CL-G4-15	29	24-34	5	0
CL-H1-11	77	52-102	25	219.71
CP-C2-11	47	29-65	18	1,516.51
CP-S2-11	47	33-61	14	0
CP-S2-17	54	46-63	9	0
CP-F1-11	44	33-55	11	5,102.29
CP-H3-13	55	34-76	21	168.37
CP-S1-21	42	28-56	14	0
CW-C3-11	88	45-131	43	107.3
CW-S3-13	116	105-127	11	25,023.97
CW-S1-17	131	80-182	51	0
CW-C4-12	126	93-159	33	47.55
CW-C1-11	114	91-137	23	3,531.97
CW-C4-11	101	72-130	29	477.32
CW-H2-11	59	28-90	31	0

From Plant Associations of the Fremont National Forest (Hopkins 1979).

3. Fire

Wildfires larger than 100 acres in size are shown in Table 16 by year of occurrence. The frequency of starts from lightning caused fire in the Warners is in the lowest range for the forest. Control of wildfires has resulted in a change of potential fire intensity from low to a more moderate regime. Fire severity has changed to a more mixed lethality severity regime due to the build up of ladder fuels and the amount of carbon stored on most sites (Table 17). Insects, disease and increased density-related mortality have increased the dead fuel component of the forested portion of the watershed.

Table 16. Wildfires From 1950 to 1997
(Greater than 100 acres)

Year	T	R	Sec	Name	Size (Acres)
	Location				
pre-1948	38S	21E	02		150
1956	38S	21E	30		11
1951	40S	22E	19	Willow Creek	207
1960	38S	22E	26	Blue Creek	435
1964	38S	22E	22	Blue Creek	170
1964	39S	20E	10	Black Cap	413
1966	39S	21E	01		11
1996	41S	21E	20		20

Fire locations can be found in the Fremont National Forest GIS.

Table 17. Deep Creek Fire Disturbance (Acres)

Frequency	Historic	Current
Frequent	103,222	44,229
Very Frequent	74,323	61,211
Infrequent	2,501	69,280
Very Infrequent	0	5,326
Severity	**Historic**	**Current**
Non-Lethal	74,890	8,274
Mixed	1,995	92,280
Lethal	103,161	79,492

Data source: ICBEMP fire data. Frequency and severity definitions are contained in the documentation for that project.

Table 17 represents the whole watershed. Changes in lethality (severity) and frequency are a result of active fire suppression. Historic fire severity shows a large acreage of lethal and nonlethal severity. Current condition shows a shift to more mixed severity. This data is extrapolated from the ICBEMP Project and only may hold credibility in very broad generalities. The disturbance regime includes the eastern portion of the watershed which is a desert shrub/grass community. Fires were historically frequent but usually lethal in the shrub community because of the intolerance of most shrubs to repeated low intensity fire. Fire maintained the plant community in a more open grass situation. Fires that occur in the grass/shrub community tend to be of a mixed lethality and occur as a mosaic on the landscape. Fire suppression in the forested community may have reduced the severity in that portion of the landscape.

There is an aggressive underburning program on the Fremont National Forest. However, little underburning has been done in this watershed. Some burning to reduce sagebrush competition and improve range condition was done in 1986 along Dismal Creek. An attempt to underburn in white fir-mixed conifer stands occurred in 1981-82 (Table 18). The results were deemed unsuccessful because of the amount of white fir mortality that occurred. The burn objective was to reduce fuel, while inducing no mortality. Current forest management objectives are somewhat different and reintroducing fire where it was part of the naturally occurring disturbance cycle now fits into the scheme of ecosystem management.

Table 18. Areas Underburned

Name of Area	Year Burned	Acres
Camas	1981	77.59
Burnt Creek	1982	66.81

4. Insects and Disease

Bark beetles have been working in the watershed. Western pine beetle is attacking large ponderosa pine, mountain pine beetle is working in the lodgepole pine and small ponderosa pine and the fir engraver is working on white fir. Fir engraver activity was extensive during the early 1990s but the other bark beetles have been endemic in the forested area and have not caused extensive mortality.

The Modoc budworm has been prevalent in the Warner Mountains for millennia. There were outbreaks of the Modoc budworm in 1982, 1986 and 1990. The insect population rises and wains very quickly in response to a naturally occurring virus. Outbreaks were short lived and little mortality occurred. Typically, Modoc budworm damage results in top kill and the associated reduction in growth. Large scale white fir mortality has occurred as a result of the long drought of the late 1980s and early 1990s. The drought left much of the white fir stressed and susceptible to fir engraver attack. Most insect attacks have been secondary mortality agents that killed trees in an already weakened or stressed condition.

Dwarf mistletoe occurs in ponderosa pine, white fir and lodgepole pine. These mistletoes are species specific and do not spread from one to another. Damage from mistletoe is potentially the greatest in single species stands with multilayered canopies and high density. Stands that have been harvested but have residual infected overstory or infected trees nearby appear to have a high potential to spread mistletoe infection to seedlings and saplings. Mistletoe appears to be on the increase because of these conditions.

Annosus root disease is prevalent in the mixed conifer stands and is especially common in pure white fir stands. Many of these stands have been entered repeatedly and the spread of Annosus is increasing. Attempts to control the spread of Annosus during timber sales using borax on freshly cut stumps were unsuccessful during the 1980s and 1990s. The prescription to treat freshly cut stumps was never completed during timber sale operations. Eglitis et al. has shown that after the second entry into a true fir or mixed conifer stand almost 100% of the white fir will be infected with Annosus (Fremont National Forest 1995).

B. Rangeland

The most obvious rangeland vegetation in the watershed is the sagebrush types: low sagebrush, big sagebrush or silver sagebrush. These shrubs are found throughout the watershed at different elevations, on different soils and on all aspects. Sagebrush shrubs are either dominant or codominant on 91% of the acres in the BLM portion of the watershed.

Range vegetation within the BLM portion of the watershed can be summarized into 11 major groups and separated by land status and subsheds. These groups and the acres in each is shown in Table 21. Public land is 67% of the total acreage (84,298 acres) and the rest is intermingled private land. The largest groups are the low sagebrush-grass (ARAR-Grass) (54%), big sagebrush-grass (ARTRV-Grass) and juniper over these sagebrush communities (JUOC-ARAR-Grass, JUOC-ARTRV-Grass). These groups occupy about 66,500 acres or 79% of the total acres in the BLM portion of the watershed. The most common community (53% of BLM acreage), low sagebrush-grass, is also the most dominant vegetation in every subshed, ranging from 21% of the vegetation in Cressler Creek to 67% in the Big Lake subshed. Big sagebrush-grass is the second most common vegetation type and is also found throughout the watershed (12% of BLM acres) but is less than 20% of the vegetation in the smaller subsheds, Cressler Creek, Big Valley, Drake and Peddlers Creeks.

Juniper-low sagebrush-grass sites are relatively rare, occupying only 4% of the total acres in the BLM portion of the watershed.

Most of the juniper-low sagebrush is found in the Big Valley subshed where it is dominant and in the Big Lake subshed. It is in these subsheds that the old growth or ancient juniper stands are most often found. The other subsheds either have none at all or very little.

The juniper-big sagebrush type occurs on about 9% of BLM-adaministered land and is found in every subshed, except Cressler Creek and Big Valley. It occupies a large part of the Gibson Canyon subshed (26%) and a significant part of the Drake (18%) and Peddlers Creek (15%) subsheds. There are more acres of the juniper-big sagebrush type in these three subsheds than there are the big sagebrush-grass type.

The other less common vegetation types are scattered throughout the subsheds in relatively low amounts except for antelope bitterbrush and mountain mahogany communities which are a significant portion (707 acres) of the Drake Creek subshed. There are only 2,403 total acres (3% of BLM acres) dominated by these vegetation types, but these communities are very important as habitat for deer and other wildlife species.

Current conditions of the vegetation within the watershed and within BLM allotments have been determined using the Ecological Site Inventory Method (ESI). This method compares the species composition of the existing community with the potential species composition of that site based on soils, topography, precipitation and elevation. The ESI method then places each site in one of the following seral stages: early, mid, late and climax. Climax resembles potential and early has less than 25% of its plant production in potential vegetation.

Only about 1% of the acreage in the BLM portion of the watershed is in the early seral stage and only about 0.1% is in the climax stage. Most of the acreage is in the mid-seral stage (77.5%), 19% is in the late stage, and 2.5% in the unknown category (Table 19). The condition of the public land (excluding the private) is a little different with only 0.3% in the early seral stage, 0.2% in the climax, 23% in late, 75% in mid and 1% is unknown. On the private lands, there is 2% in early seral stage, 82% is mid, 10% is late and 6% is unknown.

There is variation in the condition of the vegetation based on vegetation type. The ecological condition by vegetation community for all acres within the BLM portion of the watershed is shown in Table 19. Three of the four most common vegetation types, low sagebrush-grass (ARAR-Grass), big sagebrush-grass (ARTRV-Grass) and juniper-low sagebrush-grass (JUOC-ARAR- Grass), have very similar condition ratings with about 75% in mid-seral and 25% in late seral. Juniper-big sagebrush-grass (JUOC-ARTRV-Grass) is somewhat different with 95% in the mid-seral condition. This is expected as junipers have invaded the big sagebrush communities in the last 100 years and there has been a reduction in herbaceous vegetation. The increase in junipers and loss of herbaceous vegetation has resulted in a lower ecological condition rating for some of these areas. These general relationships are about the same whether on BLM or private land.

Table 19. Acres by Vegetation Type and Percent of Vegetation Type by Seral Condition
BLM Portion of Watershed

Vegetation type	Acres/Watershed/ BLM Allotments	Percent of Total Acres in Vegetation Type by Seral Stage Early	Mid	Late	Climax	Unknown
ARAR-Grass	45,114	0.4%	76%	24%	0%	0
ARTRV-Grass	10,454	1.5%	71%	27%	0%	0
JUOC-ARAR-Grass	3,027	0%	78%	22%	0%	0
JUOC-ARTRV-Grass	7,903	0.6%	95%	4%	0	0.6%
PUTR-CELE-Grass	2,403	0	49%	42%	5%	4%
ARCA	367	0	40%	19%	0%	41%
TREE Types	878	0%	48%	0%	0%	52%
Grasslike	2,640	17%	30%	4%		48%
TOTAL	84,276	1%	19%	77.5%	0.1%	2.5%

The amount of sagebrush and the species composition of the understory grasses determine the ecological condition stage for these plant communities. The low sage and big sagebrush sites in the mid-seral stage tend to be dominated by Sandberg's bluegrass and/or bottlebrush squirreltail. Other common grass species included Thurber's needlegrass, Idaho fescue and bluebunch wheatgrass. Low sagebush sites in late seral condition generally had Idaho fescue as one of the dominant understory grasses with at least 10-20% of the composition. These sites often contained a variety of other grasses such as bottlebrush squirreltail and bluebunch wheatgrass. In big sagebrush sites in the late seral stage, Idaho fescue is still one of the dominants but bluebunch wheatgrass is at least as common. To be in the late seral stage, a site must have a variety of grasses. If Idaho fescue or bluebunch wheatgrass is common, then other grasses will also be present.

Low sagebrush sites with a juniper overstory are relatively small areas (4%), but are found throughout the watershed (Table 21), and 22% of the type is in late seral condition (Table 19). Idaho fescue is the dominant understory grass and it is on these sites that much of the old growth juniper is found.

In the other less common vegetation types there is variation in ecological condition with the bitterbrush (PUTR) and mountain mahogany (CELE) communities having 49% in mid-seral, 42% in late and 5% in the climax stage.

On National Forest System lands, riparian vegetation in forested areas and restricted carry on areas is generally in proper functioning condition (Table 24). Meadow areas have typically been degraded, but recent improvement has these riparian areas on an upward trend for the most part.

Table 20. Total Acres and Percent of Acres by Subshed by Seral Stage

Subshed	Early	Mid	Seral Stage Late	Climax	Unknown	Total Acres
Gibson Canyon	0	85	14	0	0.3	13,851
Lower Deep Creek	0	60	27	2	11	6,580
Cressler Creek	0	96.5	3.5	0	0	2,492
Big Valley	0	94	6	0	0	4,824
Drake Creek	0	85	11	0	4	7,494
Peddlers Creek	2	93	5	0	0	6,488
Crane Lake	1	60	34	0	5	5,748
Big Lake	2	73	23	0	2	36,731
Total (Percent)	1	78.9	19	0.1	1	100
Total (Acres)	829	65,553	15,857	0	2,036	84,276

There are some relationships between ecological condition of the vegetation and the location of that community within the watershed. The distribution of seral stages within subsheds can be seen in Table 20. Only the Big Lake subshed had a distribution of seral stages similar to the overall distribution described earlier. The Big Lake subshed as seen on Map 2 is the biggest one within the BLM allotments and is in the north and east portion of the watershed. Only Crane Lake (34%) and Lower Deep Creek (27%) subsheds had a higher percentage of acres in late seral condition. Lower Deep Creek subshed had the only vegetation community in climax condition. The greatest amount of late seral and climax vegetation that occurs in these subsheds is found along the western edge of the watershed and adjacent to the National Forest. These areas have a higher elevation (5,800-6,300 feet) and greater precipitation than most of the watershed within the BLM allotments. The climax vegetation is a mountain mahogany-Idaho fescue community along the south slopes of Deep Creek on fairly steep terrain. The north facing aspect and the elevation combine to increase effective precipitation on this site, thereby maximizing plant production. The steep slope protected the community from the historical excessive grazing that occurred in many areas. Current livestock management results in only slight to no utilization on this site. These two subsheds also had the largest number of acres in the unknown category because of the large amount of private land.

The Cressler, Drake, Big Valley and Peddlers subsheds have 85% or more of their acreage in mid-seral condition. These are the smallest subsheds within the BLM portion of the watershed and have larger percentages of intermingled private land. As a result, there are not large blocks of public land that were too isolated to be impacted from historical uses such as excessive grazing, wood cutting and recreational uses.

There is little known about the condition of the small and scattered populations of aspen, willow and snowberry. It appears that the aspen patches in the watershed are being slowly replaced by juniper stands because of the lack of fire. There have been 63 reported fires in the watershed between 1980 and 1997, but only three were over 100 acres and only five were over two acres. The big three were 475, 200 and 150 acres.

Table 21. Acres of Vegetation Type by Subshed and Land Status
BLM Portion of Watershed

Vegetation type and Dominant Species	Land Status	Gibson Canyon	Lower Deep Creek	Cressler Creek	Big Valley	Drake Creek	Peddlers Creek	Crane Creek	Big Lake	Total
ARAR-Grass										
SIHY, POSE	BLM	5,215	2,554	539	1,232	1,374	2,248	852	21,128	35,142
FEID	TOTAL	5,236	3,212	539	1,232	4,125	3,574	2,541	24,665	45,124
ARTRV-Grass										
SIHY	BLM	1,836	1,038	350	94	131	565	598	2,381	6,993
AGSP, FEID	TOTAL	1,863	1,629	350	94	729	747	1,344	3,698	10,454
PUTR CELE										
Types AGSP	BLM	0	170	0	0	18	60	0	609	857
POA, FEID	TOTAL	0	247	0	0	707	313	0	1,136	2,403
ARCA-ELTR	BLM	0	16	0	0	136	0	0	145	297
PONE, POA	TOTAL	0	16	0	0	136	0	0	215	367
CHNA	BLM	333	0	0	0	0	0	0	0	333
STCO, BRTE	TOTAL	333	0	0	0	0	0	0	0	333
JUOC-ARAR										
Grass	BLM	144	262	25	1,199	0	0	0	1,118	2,748
SIHY, FEID	TOTAL	179	262	25	1,199	0	196	0	1,166	3,027
JUOC-ARTRV										
Grass SIHY	BLM	3,566	184	0	0	346	468	0	787	5,351
AGSP, FEID	TOTAL	3,710	246	0	0	1,338	999	50	1,560	7,903
TREE types										
ABCO, PIPO										
ARTRV, FEID	BLM	0	1,410	0	0	0	0	98	6	244
`AGSP	TOTAL	0	396	0	0	0	0	420	62	878
GRASSLIKE										
CAREX, DECE										
JUNCU, PONE	BLM	32	0	0	0	38	496	0	219	785
AGCR	TOTAL	52	350	0	0	249	659	292	1,038	2,640
ROCKLAND	BLM	2,089	171	0	0	84	0	134	1,268	3,746
	TOTAL	2,142	222	0	0	104	0	202	1,281	3,951
UNKNOWN	BLM	0	0	0	0	0	0	39	20	59

Vegetation type and Dominant Species	Land Status	Gibson Canyon	Lower Deep Creek	Cressler Creek	Big Valley	Drake Creek	Peddlers Creek	Crane Creek	Big Lake	Total
	TOTAL	336	0	1,578	2,299	206	0	899	1,890	7,228
GRAND	BLM	13,215	4,535	914	2,525	2,127	3,837	1,721	27,681	56,555
TOTAL	TOTAL	13,851	6,580	2,492	4,824	7,594	6,488	5,748	36,731	84,298

C. Noxious Weeds

Noxious weeds such as Hoary cress (Cardaria draba), Canada thistle (Cirsium arvense), Bull thistle (Cirsuim vulgare), Diffuse knapweed (Cenaurea diffusa), Spotted knapweed (Cenaurea maculosa), Field bindweed (Convolvulus arvensis), Klamath weed (Hypericum perforatum), Mediterranean sage (Salvia aethiopis) and Yellow toadflax (Linaria vulgaris) have been identified in several areas (Map 5). Two sites of Hoary cress were located. Several sites of Canada thistle have been identified along with 10 sites of Bull thistle. One site of Spotted knapweed was located on National Forest System land approximately 1/2 mile west of Deep Creek campground along the North Fork Deep Creek and one site of Diffuse knapweed located on Oregon State Highway 140. One site of Field bindweed was located west of Adel. Klamath weed was inventoried in two locations. Mediterranean sage was observed on 13 sites. One site of Yellow toadflax was sited on Oregon State Highway 140 at the Mud Creek Campground turn off. The weeds seem to be expanding each year.

D. Riparian Vegetation

An estimate of the total acres of riparian vegetation is shown in Table 22 for National Forest System land. The majority of riparian acres support coniferous and deciduous tree cover. Herbaceous meadows are the second greatest vegetation type characterizing riparian acres. Willow communities and the other shrub types make up the remainder.

Table 22. Riparian Vegetation Acres by Subshed

Subshed	Conifer	Aspen	Cottonwood	Willow	Sage	Herb	Total
Gibson Canyon	0	0	0	0	0	0	0
Drake Creek	19	1	0	0	0	0	20
Peddlers Creek	3	0	0	0	0	0	3
Blue Creek	0	0	0	1	0	0	1
Lower Deep Creek	0	4	0	0	3	1	8
Big Valley	0	0	0	0	0	0	0
Cressler Creek	34	86	0	42	27	24	213
Willow Creek	188	46	1	19	15	97	366
Dismal Creek	79	303	0	121	15	91	609
Upper Deep Creek	168	379	26	151	16	118	858
Crane Lake	231	10	0	10	18	2	271
Burnt Creek	198	167	0	63	25	161	614
Horse Creek	134	142	0	25	44	60	405
Lower Camas Creek	235	96	0	92	75	139	637
Mud Creek	246	61	0	43	35	168	553

Subshed	Conifer	Aspen	Cottonwood	Willow	Sage	Herb	Total
Twentymile Creek	0	0	0	0	0	0	0
Fifteenmile Creek	58	220	0	72	48	52	450
Upper Twelvemile Cr.	12	229	0	17	15	27	300
Totals	1,605	1,744	27	656	336	940	5,308

The vast majority of riparian types on Forest Service livestock allotments are in fair or good forage condition and display mid to late seral ecological status. Most riparian areas on these allotments, with the exception of the lowest elevation low gradient reaches and areas heavily impacted by roads, are in fair to good condition from a vegetative, soil and stream characteristic standpoint. Some of the lower gradient reaches are somewhat deficient in hardwood vegetation.

PFC ratings have been conducted on a number of stream reaches on the forest and were used to classify pastures as being in satisfactory or unsatisfactory condition (Table 23).

Table 23. PFC Ratings

Allotment	Pasture	Stream	Sensitivity	PFC Class
Barley Camp				
	Deep/Mosquito	W. Br. Dismal Cr.	High	Satisfactory
	Dismal Creek		High	Satisfactory
	Spray	N.F. Twelvemile Cr.	High	Satisfactory
	Frakes Cabin	Barley Camp Cr.	High	Unsatisfactory
	Barley Camp	Fifteenmile Cr.	Moderate	Unsatisfactory
	Cressler Creek		Moderate	Unsatisfactory
Crane/Kelly				
	Burnt Creek	Burnt Cr.	High	Satisfactory
		S.F. Willow Cr.	Moderate	Satisfactory
		Willow Cr.	Moderate	Satisfactory
	Burnt Cr. Rip.	Burnt Cr.	High	Satisfactory
	Willow Cr.	Willow Cr.	Moderate	Satisfactory
	Willow Cr. Rip.	Willow Cr.	High	Satisfactory
Crane Mountain				
	Crane Mountain	N.F. Willow Cr.	Moderate	Satisfactory
		M.F. Deep Cr.	High	Satisfactory
Horse Prairie (Hickey)		N/M		
Horse Prairie				
	Horse Prairie	Horse Prairie Cr.	Moderate	Satisfactory
	Burnt Cr. Rip.	Burnt Cr.	High	Satisfactory
	Twin Springs	Horse Cr.	High	Satisfactory
Little Cove		N/M		

Allotment	Pasture	Stream	Sensitivity	PFC Class
McDowell				
	McDowell	S.F. McDowell Cr.	High	Satisfactory
		N.F. McDowell Cr.	High	Satisfactory
	Twelvemile	Twelvemile Creek	High	Satisfactory
Porcupine				
	Porcupine	Porcupine Creek	High	Satisfactory
Rogger Peak				
	Rogger Meadow	Burnt Creek	High	Satisfactory
	Summit Prairie	Summit Prairie Creek	High	Satisfactory
Squaw Butte				
	Upper Squaw	Mud Creek	High	Satisfactory

PFC = Properly Functioning Condition: a methodology to evaluate if streams are functioning in a way to maintain proper riparian and hydrologic attributes.

Riparian vegetation types on the BLM portion of the watershed are represented by the silver sagebrush-grass (ARCA) types which occur along or around the drier riparian areas and the grasslike types which include sedges, rushes and bluegrass species (CAREX, JUNCO, POA, PONE) (Table 21). There are stringers of willows occurring along Parsnip, Camas and Deep Creeks but they were too small to be mapped separately.

The condition of riparian areas which include the silver sage type and some of the grasslike and tree types is not well quantified by the ESI method. The silver sage (ARCA) communities had 40% in mid and 19% in late seral but there was 41% unknown. The large percentage of unknown is due to the shape and size of these communities. Silver sage communities in this area tend to be stringers and strips along riparian zones and are big enough to map but too small or isolated for vegetation transects. The tree and grasslike types also had larger percentages of unknown (52% and 48%) because about two-thirds of these areas are on private land and much of that land was not sampled.

Table 24. Summary of Proper Functioning Condition Assessments of Stream Reaches on BLM and National Forest System Lands

	% Miles of BLM Stream Reach	% Miles of USFS Stream Reach
Proper Functioning Condition	66	69
Functioning at Risk Upward Trend	25	26
Functional at Risk Trend Not Apparent	6	3
Nonfunctional	1.5	3
Not Rated	1.5	~

The PFC method does not quantify ecological condition but does indicate the trend of the vegetation present. Proper functioning condition surveys showed results for Deep, Parsnip, Drake and Camas Creeks (Table 24). It appears that vegetation on most of the riparian areas is stable or in an upward trend. This correlates well with current grazing management which excludes 66% of these pubic land reaches from grazing and 25% is grazed only in the spring every other year. The remaining 9% is managed under a rotation system using stubble height as an indicator of use. These management techniques should improve vegetation conditions along riparian areas and the PFC survey tends to indicate that. There is not much information on the condition of private land riparian areas.

E. Sensitive Plants

Oregon Semaphore grass (Pleuropogon oregonus) grows on private land on both sides of Oregon State Highway 140 where Mud Creek crosses the highway. It is a Priority 1 in the Oregon Natural Heritage Plan (1998) and is on the sensitive plant species lists for BLM and USFS Pacific Northwest Region. It is to be federally listed. This grass is found on swampy ground, wet meadows and stream banks and is threatened by cattle and drought. This site covers less than one acre and is one of three for the plant in the world. The other sites are located in Harney and Grant counties in Oregon.

Prostrate buckwheat (Eriogonum prociduum) is found on dry, volcanic slopes and hills and is considered "an ash soil species". One population of two acres grows on Sagehen Butte with low sage and other drought tolerant species. In the Oregon Natural Heritage Plan (1998) it is a Priority 1; for the BLM it is on the Sensitive Plant Species List and is a plant taxa which is threatened or endangered throughout its range. It is not known to occur on National Forest System lands. There are six populations elsewhere in Lake County and it grows in California.

Blue-leaved penstemon (Penstemon glaucinus) is another "ash soil" species. It is found on fine, ashy soils or weathered tuff and can be in association with mixed conifers or sagebrush steppe at high elevations. One population on three acres grows on National Forest System land. It has not been found on BLM land. In the Oregon Natural Heritage Plan it is a Priority 1, and it is on the USFS Pacific Northwest Region Sensitive Species List. Because of its new listing, it will become a BLM sensitive plant species. It also occurs in Klamath County, Oregon.

Warner Mountain bedstraw (Galium serpenticum spp. warnerense) is found on steep slopes above active talus slopes above 4,700 feet elevation. Three populations on 289 acres grow on National Forest System land. To date none is known to occur on BLM-administered land. It also occurs in California. It is on the Priority 1 list of the Oregon Natural Heritage Plan and on the USFS Pacific Northwest Region Sensitive Species List.

Dwarf lousewort (Pedicularis centranthera) is another of the ash soil species found on hillsides above Deep Creek Canyon and on Fish Creek Rim. Five populations cover 20 acres of BLM-administered land. None is known to occur on National Forest System land. One population of 40 acres occurs elsewhere in Lake County. It also occurs on the Malheur National Forest in Harney County, Oregon and in Nevada. This species appears to respond favorably to fire with the only threat at present being grazing animals. It occurs under mixed conifers and on open slopes of juniper with very sparse or low diversity. It is a Priority 3 in the Oregon Natural Heritage Plan (species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range), on the sensitive "watch list" for the BLM and does not appear on the USFS Pacific Northwest Region Sensitive Species List.

Nodding melica grass (Melica stricta) is found on rocky slopes of low sagebrush flats and cliff edges among the rocks, such as Fish Creek Rim. It grows in three populations covering about 50 acres of National Forest System land and five populations covering about eight acres of BLM-administered land. It also occurs in four other counties in Oregon and in California and Nevada.

It is a Priority 4 in the Oregon Natural Heritage Plan, so it is a plant taxa of concern and on the "Monitor List" (taxa of concern which are not currently threatened or endangered: taxa which are very rare but are currently secure). This grass is on the USFS Pacific Northwest Region Sensitive Species List and on the BLM sensitive "watch list".

Sierra onion (Allium campanulatum) grows in well drained flat dry ground or shaded areas, rills and gravel washes. It grows in 37 locations covering 161 acres on National Forest System land. It also occurs on BLM-administered land. It has been "considered but rejected as too common" by the Oregon Natural Heritage Plan and is no longer being monitored by the BLM. It is listed on the USFS Pacific Northwest Region Sensitive Species List, but is proposed to be dropped.

Dismal Swamp Botanical Special Interest Area

The Dismal Swamp area is the only high montane (7,000 feet) freshwater marsh known on the Modoc National Forest. This freshwater marsh area of approximately 160 acres contains a diverse assemblage of plants which makes it a rare habitat type in California. Dismal Swamp is the southern most extent of the range of a rare bog birch which is proposed as a "Listed Species" by the California Native Plant Society. Dismal Swamp also contains the highest elevation occurrence of stoloniferous pussytoes, a Region 5 sensitive plant. The area provides beautiful spring wildflower displays that have been photographed and featured by popular nature magazines. The Dismal Swamp area has been recommended for designation as a botanical special interest area.

Quamasia Quamash Special Management Area (Botanical)

This area, originally established and approved in 1939, will continue to be managed to maintain a colony of common camas (Quamasia quamash) considered at the time of establishment as a vanishing species. The area is designated Management Area 7 in the Forest plan.

Stream Channel

A. Fluvial System

A list of the system's major streams and tributaries is found in Table 2 (Characterization-5).

Streams in the Deep Creek watershed include perennial, intermittent and ephemeral channels. Table 25 is a breakdown of stream miles by subshed. Map 7 shows the distribution of these stream types by subshed.

Table 25. Stream Miles by Subshed

Subshed	Perennial Miles	Intermittent Miles	Ephemeral Miles	Total Miles
Mud Creek (01)	16	19	6	41
Lower Camas Cr. (02)	22	31	12	65
Horse Cr. (03)	5	9	5	18
Burnt Creek (04)	10	4	6	20
Crane Lake (05)	9	7	8	25
Upper Deep Creek (06)	19	14	2	35

Subshed	Perennial Miles	Intermittent Miles	Ephemeral Miles	Total Miles
Dismal Creek (07)	9	10	12	31
Willow Creek (08)	14	9	4	27
Cressler Creek (09)	6	9	6	21
Big Valley (10)	9	7	3	19
Lower Deep Creek (11)	11	3	5	19
Blue Creek (12)	14	13	3	29
Peddlers Creek (13)	10	5	3	17
Drake Creek (14)	~	~	~	~
Gibson Canyon (15)	~	~	~	~
Upper Twelvemile (101)	4	1	2	7
Fifteenmile (103)	2	4	2	8
Twentymile (104)	~	~	~	~

Physical features for stream channels in Table 26 were obtained from Fremont National Forest and Lakeview Resource Area, Lakeview District, Bureau of Land Management Level II Stream Inventories. PFC analyses were performed by interdisciplinary teams for the entire reach length on BLM managed streams. Forest Service PFC analysis was done on key areas of allotments, but did not encompass the entire stream length.

Table 26. Physical Features of Stream Channels

Reach	Mean Riffle Width Ft.	Pools/ Mile (#)	LWD/ Mile (#)	Pools Mile Deeper than 2.6 Ft.	Gradient %	Unstable Banks %	PFC
Mud Creek Subshed (01)							
Mud Creek							
1	14	23	9	2	6	~	PFC
2	6	13	0	4	1	~	NA
Horse Creek Subshed (03)							
Horse Creek							
1	10	30	7	3	5	~	~
5	15	12	8	3	5	~	~
Burnt Creek Subshed (04)							
Burnt Creek							
2	11	43	0	3	4	~	~
3	9	23	7	0	12	~	~
4	10	40	1	10	2	~	~
6	6	0	0	0	1	~	~
8	6	13	1	1	5	~	~
9	5	9	1	6	1	~	~

Reach	Mean Riffle Width Ft.	Pools/ Mile (#)	LWD/ Mile (#)	Pools Mile Deeper than 2.6 Ft.	Gradient %	Unstable Banks %	PFC
Upper Deep Creek Subshed (06)							
Deep Creek - South Fork							
1	8	78	0	0	7	6	~
2	8	101	0	0	9	2	~
3	7	28	0	0	10	16	~
Deep Creek-Middle Fork							
1	23	22	11	18	2	6	~
2	22	8	14	4	4	3	~
3	18	26	6	15	5	0	~
4	17	21	0	11	2	6	PFC
5	8	34	3	0	8	1	~
6	7	13	5	0	19	2	~
North Fork Deep Creek							
1	13	40	2	0	8	~	AR^
Mosquito Creek							
1	9	55	31	~	5	~	~
2	10	56	11	~	16	~	~
3	5	50	0	~	4	~	~
4	6	46	2	~	10	~	~
Dismal Creek Subshed (07)							
Dismal Creek							
2	14	28	10	3	7	~	~
3	9	39	0	2	2	~	~
Willow Creek Subshed (08)							
Polander Creek							
2	7	111	7	0	4	~	
3	7	22	9	0	10	~	
Willow Creek							
1	7	35	8	0	3	~	PFC
2	7	63	20	1	4	~	~
3	7	30	5	1	1	~	AR^
4	10	15	0	5	1	~	~
6	6	87	113	0	1	~	~
7	4	84	72	0	4	~	PFC
8	5	73	94	0	20	~	~
9	4	75	60	0	9	~	~

Reach	Mean Riffle Width Ft.	Pools/ Mile (#)	LWD/ Mile (#)	Pools Mile Deeper than 2.6 Ft.	Gradient %	Unstable Banks %	PFC
Lower Deep Creek Subshed (11)							
5(BLM)	21	40	4	15	2.3	29	PFC
6(BLM)	26	20	2	5	0.5	27	N(0.35MI) FAR^
Blue Creek Subshed (12)							
Blue Creek							
1(BLM)	27	49	1	23	2.5	7	PFC
2(BLM)	24	28	1	11	0.2	34	FAR^
3(BLM)	33	25	13	23	3.0	1	FAR>
Peddlers Creek Subshed (13)							
Parsnip Creek							
1(BLM)	5	83	0	8	2.0	32	FAR^
2(BLM)	3	45	9	9	1.3	21	PFC
3(BLM)	5	100	0	42	2.0	1	PFC
4(BLM)	8	55	2	3	2.0	19	PFC
5(BLM)	10	58	19	2	9.0	9	PFC
Drake Creek Subshed (14)							
Drake Creek							
1(BLM)	22	18	2	9	1.0	2	PFC
2(BLM)	26	44	0	11	1.0	0	PFC
3(BLM)	18	29	0	7	1.0	1	PFC
4(BLM)	22	28	8	6	2.5	19	PFC
5(BLM)	20	39	22	14	2.5	6	PFC
6(BLM)	6	65	12	4	1.4	20	FAR^
Roaring Spring Fork							
1(BLM)	12	21	42	5	1.3	2	PFC
2(BLM)	16	27	5	11	1.2	0	PFC
Gibson Canyon Subshed (15)							
Lower Deep Creek							
1(BLM)	43	34	1	32	2.4	34	PFC
2(BLM)	41	25	0	25	1.4	28	PFC
3(BLM)	37	9	0	8	0.6	31	PFC
4(BLM)	32	23	2	14	1.7	13	PFC

Water Quality

A. General Discussion

Water quality parameters of stream temperature, fine sediment and macroinvertebrates are analyzed for current conditions. State parameters of dissolved oxygen, bacteria, total dissolved solids and toxic pollutants are not addressed as separate subjects because data is not available.

The Oregon Department of Environmental Quality developed a list of streams that do not meet requirements of the Clean Water Act for inclusion in the Environmental Protection Agency (EPA) 303(d) list. Data were provided to the State from the Forest Service and Bureau of Land Management. Streams and criteria listed in the draft 303(d) list for 1998 are shown in Table 27 and on Map 8.

Table 27. Streams on Draft 1998 EPA 303(d) List

Water Body	Boundaries	Comment	Segment
Twelvemile Creek (Twentymile Creek)	Mouth to N.F. Boundary	Temperature- Summer	42C- TWEL0
Fifteenmile North	Mouth to Headwaters	Temperature-Summer	42C-FIFTO
Twentymile Creek	Mouth to Headwaters	Temperature-Summer	42C-TWEN0
Willow Creek	Mouth to Headwaters	Temperature-Summer	42C-WILL0
Horse Creek	Mouth to Headwaters	Temperature-Summer	42C-HORS0
Mud Creek	Mouth to Headwaters	Temperature-Summer	42C-MUD0
Parsnip Creek	Mouth to Headwaters	Temperature-Summer	42C-PARS0
Polander Creek	Mouth to Headwaters	Temperature-Summer	42C-POLA0
Porcupine Creek	Mouth to Headwaters	Temperature-Summer	42C-PORC0
Burnt Creek	Mouth to Headwaters	Biological Criteria/ Temperature-Summer	42C-BURN0
Camas Creek	Mouth to Headwaters	Temperature-Summer	42C-CAMA0
Deep Creek	Mouth to Headwaters	Temperature-Summer	42C-DEEP0
Drake Creek	Mouth to Headwaters	Temperature-Summer	42C-CRAK0

All streams are listed for not meeting State of Oregon temperature standards. Burnt Creek is also listed for biological criteria which was determined to be degraded by macroinvertebrate species composition.

B. Fine Sediment

Physical samples were taken from potential spawning habitat areas or potential redd areas in gravel/cobble reaches of pool tail outs. Thirteen reaches were sampled within the National Forest boundary and two within the BLM boundary. An average of the five samples per reach was obtained and is shown in Table 28. Sieve analysis was performed in the laboratory to determine the percent fines by weight. Sieve sizes were selected using references from Reiser and Bjornn (1979). Detrimental fines are those passing the 6.4 mm sieve and smaller in excess of 25 to 30% of the substrate material.

Table 28. USFS Physical Measurements of Fines in Spawning Habitat

Subshed	Major Stream/Tributary	Elevation	% Fines < 6.4 mm	Embryo Survival
Mud Creek (01)				
	Mud Creek	6,320	40	20
	Mud Creek	6,140	19	70
	Porcupine Creek	6,500	23	65
Burnt Creek (04)				
	Burnt Creek	6,200	4	95
		5,900	32	45
Upper Deep Creek (06)				
	South Fork Deep Creek	6,080	18	70
	Mosquito Creek	6,400	19	70
Dismal Creek (07)				
	Dismal Creek	5,800	12	85
		6,900	17	80
Willow Creek (08)				
	Willow Creek	6,120	29	40
		6,060	7	90
		5,720	9	90
Lower Deep Creek (11)				
	Deep Creek	6,500	19	70
		5,480	28	40
Drake Creek (12)		5,500	27	40
		Average	20	65

C. Water Temperature

Water temperatures were taken using continuous recording thermographs. Results of stream temperature monitoring are in Table 29.

Table 29. Stream Temperature (ºC)

Subshed/Stream	Elevation		Maximum 7-Day Average Maximum Temp ºC 1992	1993	1994	1995	1996	1997
Mud Creek (01)								
Mud Creek	6,120	22.2	20.7	23.1	22.2	21.0	19.9	
Porcupine Creek	6,500	19.4	19.7	23.0	19.2	21.0		
	6,520	20.7						
Lower Camas Creek (02)								
Camas Creek	5,500		19.0	26.8	23.5			
Rosa Creek	5,940		15.5					
Horse Creek(03)								
Horse Creek	5,600		21.2					
	5,760		16.1	25.3	25.0			
Burnt Creek (04)								
Burnt Creek	5,640			28.6	25.9	26.3		
	5,910				24.7	26.3		
	6,240	16.1	23.3	20.5	22.2	23.9	22.8	
	6,600				5.9			
Crane Lake (05) No perennial stream								
Dismal Creek (07)								
Dismal Creek	5,760		16.1	18.2	16.2		18.1	
Willow Creek (08)								
Willow Creek	5,760			26.1	22.3	23.7	21.9	
Polander Creek	5,620		25.2	20.9	15.9			
Lower Deep Creek (11)								
Deep Creek	5,700	20.5	24.2	20.5		23.6		
	5,519		20.5	26.9	25.0		26.1	
	5,459		22.4	28.3	26.2	24.2	26.0	
Blue Creek (12)								
Camas Creek	5,442		20.9	29.0	20.6	24.0	24.9	
	5,415		20.4	30.2	24.6	26.0	25.2	
Peddlers Creek (13)								
Parsnip Creek	5,478		17.1		19.1	20.4	19.8	
	5,130		20.4		23.0	24.0	23.6	
Drake Creek (14)								
Drake Creek	5,458						22.4	
	4,998						26.4	

Subshed/Stream	Elevation	Maximum 7-Day Average Maximum Temp ^{o}C 1992	1993	1994	1995	1996	1997
Gibson Canyon (15)							
Deep Creek	4,980		20.8	26.8	25.7	25.6	25.1
	4,605		20.5	25.8	33.4	24.3	
Twentymile							
Twelvemile	6,400			14.2			
N.F. Twelvemile	6,600			18.7			
Fifteenmile	6,000		23.9				22.3

D. Macroinvertebrates

Aquatic macroinvertebrates are an important component of aquatic ecosystems. Macroinvertebrates process vegetative material that enter streams and are an important food source for fish. Species of macroinvertebrates vary greatly depending on the water quality within the stream. Chemical and biological conditions and amount of sediment in the stream all influence macroinvertebrate ratings. Macroinvertebrates were used by the Fremont National Forest to monitor Burnt and Willow Creeks in 1989, 1990 and 1994. The Lakeview Resource Area, Lakeview District, BLM monitored Deep, Parsnip, Twelvemile and Camas Creeks in 1989 through 1994. Data from 1994 was not summarized at the laboratory. Table 30 gives the rating for aquatic health.

Table 30. Macroinvertebrate BCI Rating*

	1989	1990	1991	1992	1993	1994
Forest Service Sites						
Burnt Creek	69	66-67				57
(Elevation 5,920)	(Poor)	(Poor)				(Poor)
Willow Creek	98	81-86				60
(Elevation 6,000)	(Excellent)	(Good)				(Poor)
BLM Sites						
Deep Creek 1		76-75	75	70	66	
(Elevation 5,520)		(Fair)	(Fair)	(Poor)	(Poor)	
Deep Creek 2		79-77	74	73	67	
(Elevation 5,004)		(Fair)	(Fair)	(Fair)	(Poor)	
Parsnip Creek		70-62	62		62	
(Elevation 5,260)		(Poor)	(Poor)		(Poor)	
Twelvemile Creek 1		85-80	78	65	73	
(Elevation 5,040)		(Good)	(Fair)	(Poor)	(Fair)	
Twelvemile Creek 2	91-96	83-79	69	78	76	
(Elevation 4,635)	(Excellent)	(Good-Fair)	(Poor)	(Fair)	(Fair)	

	1989	1990	1991	1992	1993	1994
Camas Creek 1 (Elevation 5,440)		85-82 (Good)	79 (Fair)	75 (Fair)	82 (Good)	

*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 and the USDI, BLM laboratory in Logan, Utah. A Biotic Condition Index (BCI) of each site was determined by the laboratory and is used in evaluation of the stream systems.

Macroinvertebrate samples generally show an overall decline in habitat conditions since monitoring was started in 1989. However, 1994 was a low flow year. The previous Dairy/Elder and South Creek Watershed Analysis showed that the low flow was approximately 40% of the normal low flows, as determined by long term averages. Flows in other years are a data gap.

The following narrative was excerpted from writeups provided by the USDA Forest Service laboratory in Provo, Utah for Forest Service sites.

1. Burnt Creek (1990)

The macroinvertebrate community was dominated by sediment tolerant taxa. Organic enrichment was also indicated in this stream reach. The potential for a fishery at this station appeared to be fair. This stream had a poor BCI for all periods of measurement which indicates extreme stress conditions were present in this stream reach. It appeared that there may be opportunities for management to improve water quality, instream habitat quality and possibly riparian habitat quality.

2. Willow Creek (1990)

There were indications of some sedimentation and organic enrichment at this station. The BCI of 81 indicated this stream was in good condition but could be better. Both periods prior to 1994 showed good to excellent BCI ratings. There appeared to be a fairly good potential for a fishery at this station. It appeared there may be some opportunity for management to improve the instream habitat quality and possibly water quality.

The BCI ratings for BLM sites were provided by the USDI BLM laboratory in Logan, Utah. The indicators of slight to moderate organic enrichment was found at all sites monitored. Sediment was not addressed by the BLM laboratory.

E. Municipal Water Supply

Two spring collection facilities are located in Upper Deep Creek subshed for municipal water for the Town of Lakeview. The location is NE1/4, Section 29, T. 39 S., R. 21 E., W.M. The contributing watershed for these collection boxes is less than 100 acres and has not been delineated on the ground. The condition of this area is unknown and ground review is needed to evaluate the condition of the spring source, watershed condition and management impacts.

Drinking water supplies are regulated through the Safe Drinking Water Act. Recent revisions to the Act put emphasis on "Source Area Management". Federal land management agencies have the responsibility to provide water which, with adequate treatment by the purveyor, will meet drinking water requirements.

F. Point Sources of Pollution

There are no known point sources of water pollution within the watershed.

G. Water Quality Summary

Most water quality stream temperature measurements were higher than State standards. Dismal, Twelvemile and Rosa Creeks were the only streams measured that met State water quality standards (Dismal Creek was marginal in 1994 and 1997). Sediment is generally within a range that is acceptable for fisheries with less than 15% of the measured sites exceeding the recommended 30% level for fines.

Species and Habitats

A. Terrestrial

1. Threatened, Endangered and Sensitive Species

a) Northern Bald Eagle (Threatened)

There are no known active or historic bald eagle nests or roost sites on BLM-administered or National Forest System lands. Isaacs and Silovsky (1981) characterized potential eagle nest and roosting areas for the Fremont National Forest and did not describe any portion of the Deep Creek watershed as potential habitat. Private lands around Adel do attract bald eagles in winter when climatic conditions (low ice years) and availability of carrion (deer, livestock and waterfowl) allow.

b) American Peregrine Falcon (Endangered)

The presence of potential habitat on Fish Creek Rim and historical observations was the driving force for peregrine releases at the Crump Lake hack site in the early 1990s. However, habitat potential is marginal because 1) the primary prey base of spring and fall migrants of neotropical birds, shorebirds and waterfowl is sporadic because of drought cycles (last witnessed in the late 1980s and early 1990s), 2) nesting substrate is limited by exposure (some of the best cliff faces are north or northeast facing - generally avoided by nesting raptors) and 3) proximity to prey base limits nesting use near the top of the rim. Four peregrine sightings were reported in the 1970s in the areas of Warner Canyon, Walker Canyon, Peddlers Creek and Mud Creek.

The Warner Basin is currently at a near historic high water level and waterfowl and shorebird numbers have greatly increased since the last drought cycle.

Boyce and White (1980) characterized peregrine nesting habitat on National Forest System lands. Of eight cliff sites assessed, none were rated as a priority for reintroduction (Table 31). None of these sites were identified as active, and none have been surveyed for peregrine occupancy since 1980. There are no sites designated as Management Area 2.

Habitat for prey species and hunting within the forested area of the watershed has improved with the removal of late seral forest and the corresponding increase in more open early seral forest cover types as a result of evenaged timber harvest. Most areas opened up in the 1980s, however, have since reforested. Disturbance sources have increased with a higher road density, more commercial logging activity and greater recreational use of the area since 1950.

Table 31. Peregrine Cliff Site Evaluation
(Boyce and White 1980)

Cliff Site	Potential
Willow Creek	Unsuitable
Willow Point/Crane Mt.	Low
S. Fork Cogswell Creek	Low
Kelly Creek	Medium
Drake Peak Lookout	Medium
Mud Creek	Medium
Drake Peak	High
Peddlers Creek	High

c) Western Sage Grouse

Western sage grouse surveys conducted in 1980 revealed leks ranging from five to 75 birds in size. Western sage grouse have been observed wintering in the area on windswept ridges and low sage flats and broods have been seen in the area throughout the summer. However, no crucial wintering or nesting habitat has been identified. Adult sage grouse require sagebrush year-round for food and cover and broods require forbs and insects for food.

Though no sage grouse habitat studies have been established in the watershed, during wet springs, forb production remains high and does not appear to be limiting grouse production. Current livestock management designed to comply with Section 7 consultation restrictions to benefit Warner sucker habitat and populations has shown some benefit to sage grouse and should continue to improve riparian areas, upland meadow forb production and increase residual nesting cover in the future. Sage grouse habitat condition can be inferred through interpretation of range studies and ecosite inventory data.

d) California Bighorn Sheep

California bighorn sheep numbers on Fish Creek Rim have increased steadily since the reintroduction of 15 animals in 1986. Habitat conditions appear adequate to support ODFW's goal of 100 animals. Bunchgrass communities on the face of the rim have benefited from small wildfires caused by lightning strikes.

2. Keystone Species

a) Big Game

Mule deer habitat conditions for the 25,000 acres of BLM-administered crucial winter range are generally satisfactory (Map 3). There are 3,000 to 4,000 acres of fairly young, vigorous antelope bitterbrush and 500 to 1,000 acres of curl-leaf mountain mahogany within the BLM crucial deer winter range portion of the watershed. There are some stands of decadent bitterbrush with very little recruitment of young plants because of heavy browsing pressure by deer and elk. However, the majority of bitterbrush range rates as satisfactory with adequate seedling replacement. The remaining winter range area is a mixture of low and big sage communities.

The expanding Warner Rocky Mountain elk herd which is currently at 150 animals with a management objective of 500 animals appears to be doing well. No serious competition for winter browse (bitterbrush and mountain mahogany) with deer or grass with livestock has been documented yet.

Pronghorn habitat is adequate to support the current number of animals utilizing the watershed. Maintenance of sagebrush habitats with a diversity of forbs through current livestock grazing management or prescribed burning is essential to lactating does and key to pronghorn productivity and survival. A large catastrophic wildfire or major aroga moth infestation could severely affect pronghorn or sage grouse habitat.

The current wildlife animal unit month allocation of 440 (equal to the entire allocation for the 500,000 acre Beaty Butte allotment) appears to be adequate to support the current number of deer, elk, pronghorn, sage grouse and other grazing wildlife species on BLM-administered lands. However, a future adjustment may be needed to accommodate the expanding elk herd. A catastrophic wildfire or major tent caterpillar infestation could negatively affect deer and elk habitat.

The forested portion of the watershed serves primarily as big game summer, transition and fawning/calving habitat. There are only 494 acres of designated deer winter range on National Forest System land (Map 3). Forested hiding cover ranges from a low of 0% in the Big Valley and Gibson Canyon subsheds (dominated by nonforest habitat) to a high of 65% in the Willow Creek subshed, with an overall average of 26% for the watershed (Table 32). A 40/60 cover-forage ratio is recommended as optimal (Thomas 1979).

From the 1950s through the 1980s logging activity created openings and increased edge habitat in the forest landscape, which improved overall forage conditions on summer range. Deer numbers during this period fluctuated greatly. Population indices calculated to five-year averages peaked in the early 1950s and reached the lowest levels in the early 1980s.

Logging activities in the 1950s began to decrease hiding cover and increase motorized access to summer ranges. In the later half of the century, high road densities and reductions in available cover reduced deer habitat suitability in many areas.

Road densities within subsheds on National Forest System lands vary from a low of 0.4 mi/mi^2 in the Upper Twelvemile subshed to a high of 5.1 mi/mi^2 in the Mud Creek subshed. Average road density for the watershed is 2.4 mi/mi^2 (Table 32).

Table 32. Hiding Cover and Road Densities on National Forest System Lands

Subshed	Total ac.	Hiding Cover ac.	% Cover	Road Miles	Road Density
Twentymile Creek	10	8	0.80	0.29	18.56
Willow Creek	2,881	5,587	0.64	111.88	5.11
Burnt Creek	2,265	5,059	0.60	69.66	5.08
Upper Deep Creek	8,446	4,895	0.58	57.84	4.40
Mud Creek	8,419	6,997	0.50	48.01	4.26

Subshed	Total ac.	Hiding Cover ac.	% Cover	Road Miles	Road Density
Lower Camas Creek	7,213	10,488	0.49	97.22	2.92
Fifteenmile Creek	8,774	1,380	0.48	23.3	2.70
Upper Twelvemile Cr.	6,407	1,028	0.45	29.26	2.63
Dismal Creek	5,530	2,650	0.41	11.43	2.54
Horse Creek	14,013	2,452	0.34	41.27	2.27
Cressler Creek	21,283	1,688	0.31	22.95	1.74
Crane Lake	11,618	3,025	0.26	19.59	1.67
Lower Deep Creek	7,087	573	0.08	24.08	1.57
Peddlers Creek	7,524	318	0.04	27.93	1.29
Drake Creek	9,838	1,332	0.03	75.39	1.25
Blue Creek	38,519	247	0.03	12.48	1.13
Gibson Canyon	13,851	55	0.00	4.1	0.54
Big Valley	4,824	1	0.00	1.4	0.40
Deep Creek Watershed Values:			0.26		2.41

* Hiding cover analysis does not include 1,544 acres on the Modoc National Forest or eastern portions of the Drake and Gibson Creek subsheds.

b) Beaver

Although no beaver population or habitat surveys have been conducted in the watershed, beaver habitat is gradually improving with the current livestock grazing management designed to benefit Warner suckers. Willows are reestablishing in areas previously occupied. Two other key foods, cottonwood and aspen, although still limited in number and distribution, are also showing some sign of limited recovery in small areas. The current wet cycle allows beavers to colonize areas previously unavailable during the drought of the early 1990s.

Potential habitat occurs in areas with riparian habitat and some level of deciduous vegetation. Current beaver numbers are probably lower than those occurring before the onset of trapping and intensive land use management.

c) Nongame Species

No nongame or neotropical bird surveys have been conducted in the watershed. Species dependent on sagebrush would require maintenance of a multi-aged sagebrush habitat component with a diverse grass and forb understory. Riparian area dependent species will benefit from current grazing management and future aspen/cottonwood management.

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

a) General

There is no designated LOS forest cover on BLM-administered lands within the watershed. Dedicated old growth forest habitat (Management 14) occurs on 1,546 acres, or 2% of Forest Service acres (Map 13). Another 1,655 acres were classified as old-growth, but were not designated for management in the Forest Plan (Table 33). 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 an unraveling of late/old seral forest characteristics. The forest landscape is now fragmented by patches of early and mid-seral stands.

Table 33. Old Growth and LOS Acres

Subshed	MA 14 OG Acres	"Other" OG Acres	LOS Acres
Twentymile Creek	0	0	0
Mud Creek	0	0	3,712
Willow Creek	332	210	4,487
Burnt Creek	147	107	4,555
Horse Creek	0	0	3,101
Lower Camas Creek	221	21	4,587
Cressler Creek	0	36	684
Dismal Creek	303	265	1,596
Fifteenmile Creek	0	0	623
Crane Lake	0	0	1,491
Upper Deep Creek	542	1,026	4,109
Peddlers Creek	0	0	0
Blue Creek	0	0	22
Gibson Canyon	0	0	0
Drake Creek	0	0	171
Lower Deep Creek	0	0	189
Big Valley	0	0	684
Upper Twelvemile Cr.	0	0	73
Deep Creek Totals	1,545	1,665	30,084

Average and maximum patch sizes of late/old seral forest have been reduced. Average Interior LOS patch size is 22.5 acres and overall area of interior habitat is currently 30,084 acres (Table 34). Many patches which 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 2.4 mi/mi^2 has added to the increase in edge and reduction of interior habitat. Road densities exceed 2.0 mi/mi^2 in 10 of the 18 subsheds (Table 32).

Table 34. LOS and Interior Habitat

Subshed	Acres Interior	Interior % LOS	Numbers	Patch Acres	Patch Mean Acres	Patch Max
Twentymile Creek	0	0		0	0	0
Mud Creek	430	11.6		75	5.7	55.6
Willow Creek	1,373	30.6		61	22.5	267.0
Burnt Creek	1,601	35.1		46	34.8	590.4
Horse Creek	1,072	34.6		46	23.3	149.4
Lower Camas Creek	1,232	26.9		76	16.2	236.4

Subshed	Acres Interior	% LOS Interior	Patch Numbers	Patch Mean Acres	Patch Max Acres
Cressler Creek	67	9.8	13	5.2	35.8
Dismal Creek	491	30.8	24	20.5	302.0
Fifteenmile Creek	46	7.4	11	4.2	25.4
Crane Lake	443	29.7	21	21.1	139.0
Upper Deep Creek	1,803	43.9	41	44.1	690.3
Peddlers Creek	0	0	0	0	0
Blue Creek	0	0	1	0.2	0.2
Gibson Canyon	0	0	0	0	0
Drake Creek	7	4.1	4	1.7	2.5
Lower Deep Creek	71	37.6	1	71.0	71.0
Big Valley	0	0	0	0	0
Upper Twelvemile Cr.	1	1.4	2	0.5	0.6
Watershed Values (not broken on subshed boundaries)	8,704	28.9	384	22.5	807.4

b) Goshawk

There is at least one known and one suspected active goshawk nest site within the watershed. Three historic nest sites (1980s and 1990s) have been recorded and occurred in the Cressler and Willow creek subsheds. Surveys for active territories have not occurred across the entire watershed, therefore active nest sites may exist that have not been discovered. Potential habitat exists in most LOS and mid-seral forest stands.

c) Pileated Woodpecker

There are no known active pileated woodpecker nest sites within the watershed. However, a few pileated sightings and foraging areas have been reported throughout the watershed in the early 1980s and early 1990s. No formal pileated woodpecker surveys have been conducted.

Potential habitat exists within 21,259 acres of mixed conifer LOS stands, but inadequate snag and down log abundance and small LOS patch size may preclude the ability to support breeding pairs of pileated woodpeckers over many of these acres.

d) American Marten

There have been no marten sightings recorded or surveys conducted within the watershed. Suitable marten habitat is represented in the 2,671 acres of LOS lodgepole pine and, to a lesser extent, in larger patches of mixed conifer (pine associated) LOS stands with heavy amounts of snags and down logs. Abundant down wood is a necessary habitat component. Since the down wood component was not evaluated, an accurate estimate of suitable marten habitat cannot be stated.

Decreased patch size and interior habitat have created less than optimal condition for marten in roaded portions of the watershed.

e) Black-backed/Three-toed Woodpecker

There have been no woodpecker surveys conducted within the watershed.

Like marten, black-backed and three-toed woodpeckers are associated primarily with areas of LOS lodgepole pine and somewhat with mixed conifer. These birds, however, require a constant supply of snags in the home range to make the habitat suitable. Large patches of snags, such as those created by a stand-replacement fire or insect outbreak, are often key habitat components in maintaining optimum densities of black-backed and three-toed woodpeckers. Since the snag component was not evaluated, an accurate estimate of black-backed/three-toed woodpecker habitat suitability is not possible.

4. Dead Wood Habitat Management Indicator Species

a) Primary Excavators

Survey information on snag density and distribution and primary excavator populations was not available to quantify current levels of population viability. However, 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, undoubtedly have experienced a decline in habitat suitability/availability and bird distribution and numbers. Currently, potential habitat for these species exists within the 5,470 acres of LOS ponderosa pine. This decline is a result of forest succession from an open pine to a more dense mixed conifer dominated forest with a large component of late/old white fir in most stands above 6,000 feet elevation. Stand succession and fire suppression have also increased stand density to the detriment of these species, which prefer more open understory stand structure.

5. Aspen/Deciduous Riparian Habitat Management Indicator Species

a) Red-naped Sapsucker

There have been no sapsucker surveys conducted within the watershed.

Late and old aspen clones, the preferred habitat of both red-naped and red-breasted sapsuckers, has very limited distribution, with only about 4,000 acres of aspen occurring in the watershed. Many clones are generally in a decadent condition with little if any regeneration evident to replace the stands. Ungulate grazing in some areas continues to damage or destroy much of the limited regeneration that does occur. Many clones are mixed with conifer species that contribute to the decline of the stand. The distribution and total acres of aspen are undoubtedly less than what occurred 50 or 100 years ago.

B. Aquatic

Streams support populations of several species of game fish including redband trout (Oncoryhnchus mykiss), stocked hatchery rainbow trout (Oncoryhnchus mykiss) and brook trout (Salvelinus fontinalis). Nongame fish species include speckled dace (Rhynicthis ossculus) and Warner sucker (Catastomus warnerensis). Tables of fish distribution in the Deep Creek drainage are found in the Appendix (ODFW 1990). Generally, rainbow trout are found in lower Deep Creek between the confluence of Drake and Camas Creeks and redband trout are found in most of the streams surveyed. Brook trout were found only in Upper Mud Creek. Speckled dace were found in the lower reaches of Deep Creek and intermittently in Mud and Willow Creeks. The samples were taken with single pass electrofishing without blocknets and therefore represent a known minimum number of fish.

Redband trout are a Forest Service Pacific Northwest Region sensitive species. Inland redband trout are defined as an all inland, nonanadromous rainbow population occurring in central and eastern Oregon desert streams. According to Behnke (1992), several desiccated basins west of Alvord Basin and north of Lahontan Basin have the interior redband trout as their native trout species. The watershed is in the Warner Basin and is one of the interior redband trout basins.

Since 1990, the only hatchery fish released into the Warner Basin are in ponds and reservoirs. None are released into streams.

The genetic status of the trout currently found in the Deep Creek drainages is not known. Based on comparisons with specimens collected by Snyder in 1904, Behnke (1992) feels that the redbands in Warner are hybridized, more so now than for collections made in 1968.

The Warner sucker is found only below Deep Creek Falls. The reach of Deep Creek between the falls and Adel was surveyed in 1990 and 1994, no suckers were found (White et al. 1990, Allen et al. 1994). The original description of the Warner sucker was made from specimens collected from Deep Creek (at the time, Warner Creek) by J. O. Snyder (1908) and one sucker was captured in this reach of Deep Creek by a group doing food habitat availability for White Pelicans (Smith 1984).

A draft recovery plan for the native fishes of Warner Basin has been prepared (USFWS 1997). This plan covers both Warner sucker and Warner Valley redband trout. The criteria for recovery of the Warner sucker as they apply to Deep Creek include:

1. Self-sustaining metapopulation is adequately distributed throughout the basin including Deep Creek below the falls.

2. Adequate passage is restored within and among the drainages including Deep Creek below the falls so that the individual populations of Warner suckers can function as a metapopulation.

3. Determine stream flows required for Warner sucker recovery in the Warner Basin including Deep Creek.

4. Develop plans for securing stream and spring flows to assure adequate habitat for Warner suckers in the basin including Deep Creek.

1. Fish Habitat

Physical characteristic of pools per mile, deep pools, wetted width, large woody debris, bank stability and proper functioning condition ratings are summarized in Current Conditions-26.

Stream temperature and fines in the spawning substrate are summarized in Current Conditions-31.

2. Fish Barriers

The following locations have been identified as having conditions that make fish movement difficult or impossible.

Deep Creek. The falls are a major barrier to upstream movement of all species. There is a steep gradient culvert in Reach 5.

Drake Creek. There is an eight-foot falls below Oregon State Highway 140 that is a barrier to fish movement. At the confluence with the channel from Crump Reservoir, the debris dam left from the 1984 wash out is a barrier both up and down stream.

Mosquito Creek. A barrier falls occurs at the west side of Section 12, T. 41 S., R. 21 E., W.M.

Human Uses

Human use patterns during the current period within the boundaries of the Deep Creek watershed have followed along the lines of resource extractive activities. The resources were abundant and removed as needs increased within the parameters of the marketplace.

A. Timber

Before World War II, timber harvesting was limited and dependent on the lumber demands of the local and subregional market. The small communities and ranches in the area were growing and needed a good supply of cheap wood products. Infrastructure was limited predominantly to a single purpose in a specific direction. Roads were fairly easy to construct, but were only built for timber removal. Timber harvest became more frequent and widespread following the end of World War II (Table 35). The increased demand for raw materials for building and stable prices encouraged increased harvest activities within the forested environment. Almost all the roads and other infrastructure construction and improvements came about as part of the effort to remove the large ponderosa pine trees.

Table 35. Timber Harvest

Harvest Type	Harvest Definition	Acres	% of Harvest	% of Watershed
HCC	Clear Cut	2,730	29.5	1.52
HOR	Overstory Removal	4,110	44.3	2.28
HPR	Partial Removal	334.8	3.6	0.19
HSH	Shelterwood	176.9	1.9	0.10
HITM	Individual Tree Mark	107.8	1.1	0.01
HTH	Commercial Thinning	1,045.4	11.3	0.58
HXX	Unknown Type Cut	453.3	4.9	0.25
NULL	No Data	47.9	0.5	0.00
Barley	Barley TS (No Data Entered)	265.3	2.9	0.15
	Total	9,271.4	100	5.08

Harvesting of the large pine increased throughout the current period. The harvest records of the Lakeview Ranger District and personal communication with long-term district employees indicate a steady increase of timber harvest levels through the 1970s and 1980s. The major roads, which are paved today, were built during the 1960s and 1970s as well as a high percentage of the gravelled, log hauling roads (Table 32).

During the current period, several lumber mills in the Lakeview area built to receive timber off the forest opened, operated and closed. The majority of these mills fed a large market circle and at one time employed up to half of the area's employable workers. They were significant contributors to the local and regional economy.

About 1990, factors set in to drastically reduce the volume of logs coming out of the watershed. Factors included implementation of the Forest plan, the screens and concerns from the environmental community. Since the watershed does not have a large amount of dead and dying timber, the focus for volume removal is on thinnings and other removal strategies. Timber volume levels coming off the watershed now are about one-tenth of the harvest produced during the peak years.

B. Range

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

Control of the grazing program was just coming into focus at the start of the current period. Conversion of sheep allotments to cattle took place at the beginning of the current period. The last sheep allotment was terminated in the 1960s. In the earlier part of the current period, the range allotments were changed from one large allotment to several smaller allotments. Cattle have dominated as the range animal for the largest part of the current period.

Presently, there are 20 grazing allotments within the watershed. Eleven grazing allotments occur within the BLM portion of the Deep Creek watershed, but only five (0200 Blue Creek, 0201 Vinyard Individual, 0202 Hickey Individual, 0206 Lane Plan II, and 0208 Sagehen) allotments are entirely within the watershed. All five allotments had a biological evaluation completed in 1994, and it was determined that livestock grazing on public land had no affect on the Warner sucker in the (0200) Blue Creek allotment and the determination in the other four allotments was "May affect, not likely to adversely affect".

There are portions of six other BLM grazing allotments within the watershed (Flynn 0501, Fitzgerald 0502, Lynch-Flynn 0520, Crump Individual 0204, Lane Plan I 0207, and Schadler 0209). These six also had biological evaluations in 1994 of grazing on public lands and the determination was "No Effect" on Warner sucker and their habitat.

Early in 1982, the BLM implemented a strategy for setting management priorities among grazing allotments. All allotments in the Lakeview District were categorized into one of three groups: improve (I), maintain (M) and custodial (C). I category allotments are those with unsatisfactory range resource conditions or conflicts with potential to improve and receive the first priority for investment. M category allotments are those where range conditions are generally satisfactory and the goal is to maintain those conditions. C category allotments are to be managed in a custodial manner to avoid deterioration of current resource conditions, may have a low percentage of public land, may have been designated for disposal, or may not have much potential for improvement. Of the 11 affected allotments, five are I category allotments, three are M and three are C.

Current livestock grazing allotments are described below and shown on Map 6.

Livestock Grazing Allotment Summaries (BLM)

The Blue Creek allotment (0200) has a small percentage of public land (600 acres) mostly in the Drake and Peddlers Creek subsheds. It is listed as a C category allotment. There are 131 AUMs of grazing preference authorized on the public land in the allotment.

The Vinyard Individual allotment (0201) is listed as an I category allotment. Deep Creek flows through the allotment, but except for a few watergaps, is now excluded from livestock grazing. The 510 AUMs of active preference are authorized on 8,600 acres of public land. The allotment is grazed spring and summer under a rest rotation grazing system.

There are 1.7 miles of Camas Creek and 0.5 miles of Drake Creek within the allotment. Both are excluded from grazing. There is also 8.5 miles of Deep Creek on BLM within the allotment and 8.1 miles are excluded from grazing except for four small watergaps spread out along the creek. There are 0.4 miles of Deep Creek on BLM and 0.75 miles of private land being grazed within the FRF pasture south of Rogers' ranch. This 0.4 mile portion of Deep Creek flows along the boundary between private and public land.

The Hickey Individual allotment (0202) is listed as an M category allotment. Camas and Parsnip creeks flow through the allotment and are grazed as riparian pastures with early use one year and rest from grazing the second. Five hundred eighty three AUMs of active preference are authorized on 11,318 acres of public land. The allotment is grazed spring, summer and fall under a rest rotation grazing system.

Parsnip Creek flows for 2.4 miles through the allotment with 1.4 miles excluded from grazing except for two small watergaps. There is one mile being grazed every other year for four to six weeks in the spring. There is also spring grazing (two to four weeks) every other year on the 1.9 miles of Camas Creek. There is a 0.5 mile reach of Drake Creek on public land that is excluded from grazing. There is an 0.8 mile reach of Parsnip Creek on private land that is grazed at various times during the year.

The Crump Individual allotment (0204) is listed as an I category allotment. About 11% of the 2,930 acres of public land in this allotment falls within the watershed. There are no perennial streams in this section of the allotment. There are 92 AUMs of active preference authorized on 2,930 acres of public land. The allotment is grazed spring and summer.

The Lane Plan II allotment (0206) is listed as an I category allotment. Parsnip and Drake Creeks flow through the allotment. Parsnip Creek is almost entirely on private land and the 2.75 miles of Drake Creek is almost entirely on public land. About 0.25 miles of Drake Creek is fenced off from livestock grazing and the lower 1.0 mile is virtually excluded by steep and rocky terrain. The 1.5 mile reach is grazed every other year in the spring. There is also a 0.75 mile Roaring Springs Fork of Drake Creek that is grazed the same as Drake Creek. The 450 AUMs of active preference are authorized on 9,910 acres of public land. The allotment is grazed spring and summer under a rest rotation grazing system.

The Lane Plan I allotment (0207) is listed as an M category allotment. About 25% of the 24,725 acres of public land in the allotment lie within the watershed. No perennial streams flow on the portion of the allotment included in the watershed, though Squaw Creek, an intermittent stream, is a tributary of Deep Creek. The 1,942 AUMs of active preference are authorized on 24,725 acres of public land. The allotment is grazed spring, summer and fall under a rest rotation grazing system.

The Sagehen allotment (0208) is listed as an M category allotment. Deep Creek flows through the allotment with 1.2 miles on public land and 5.3 miles on private land. The private land owner recently agreed to cooperatively manage his land with the public land to meet riparian improvement objectives. The pasture is now grazed to meet utilization guidelines. A short watergap is provided for livestock on Camas Creek. The 266 AUMs of active preference are authorized on 3,820 acres of public land. The allotment is grazed under a deferred rotation grazing system.

The Schadler allotment (0209) is listed as a C category allotment. Sagehen and Crane Creeks flow through the allotment almost entirely on private land. About 70% of the 790 acres of public land in the allotment lie within the watershed. There are 57 AUMs of active preference authorized on 790 acres of public land. The allotment is grazed seasonally.

The Flynn allotment (0501) is listed as a C category allotment. Drake Creek flows through the allotment mostly on private land. About half of the allotment lies within the watershed and the other half is by Hart Lake. There are about 1,340 acres of public land within the watershed and about 60 AUMs of active preference are authorized on this public land. The allotment is grazed seasonally. Because of the large amounts of private land fenced in with the few acres of federal range the term "Fenced Federal Range" or FRF is used when describing the allotment. In addition, the grazing administration of these FRF allotments is minimal. Cattle use is authorized on an annual basis. The cattle using this area do not stay for any length of time on the BLM-administered land. The private land is divided into several pastures which contain the major water sources. The area serves as a gathering and holding pasture for the cattle moving from the BLM and private land to the Forest Service allotments.

The Fitzgerald allotment (0502) is listed as a C category FRF allotment. The allotment has three use areas, McDowell Creek pasture is the only one in the watershed. Cattle use is authorized on an annual basis. The actual grazing period that normally occurs in the McDowell Creek pasture is March 1 through November 15 annually. The cattle using this area do not stay for any length of time on the BLM-administered land. The area serves as a gathering and holding pasture for the cattle moving from the BLM and private land to the Forest Service allotments. Drake Creek flows through the allotment entirely on private land. About 3% of the 5,150 acres of public land in the allotment lie within the watershed. Three hundred twenty nine AUMs of active preference are authorized on 5,150 acres of public land. The allotment is grazed seasonally.

The Lynch-Flynn allotment (0520) is listed as an I category allotment. No perennial streams flow through the allotment. There are about 12,368 acres of public land in the allotment within the watershed. The allotment is grazed spring and summer under a rest rotation grazing system.

Livestock Grazing Allotment Summaries (National Forest)

The grazing management strategy on National Forest allotments has been classified under the Forest Range Environmental Study (FRES). FRES strategy A is Environmental Management Without Livestock. Livestock is excluded by various methods such as riding and fencing. FRES strategy B is Environmental Management With Livestock. Livestock use is within the apparent present capacity of the range environment. Investments for range management are applied only to the extent required to maintain the environment at a stewardship level in the presence of grazing. FRES strategy C is Extensive Management of Environment and Livestock. Management systems and techniques are applied as needed to obtain relatively uniform livestock distribution and plant use and to maintain plant vigor. FRES strategy D is Intensive Management of Environment and Livestock. All available technology for range and livestock management is considered. Management seeks to maximize livestock forage production consistent with constraints of maintaining the environment and providing for multiple use.

Barley Camp allotment (A033) consists of 16,362 acres and is currently managed as a three pasture deferred rotation system under FRES strategy D for 783 cow/calf pairs under a permitted season of 7/1 to 9/30. The stock is rotated through the pastures starting at the lower elevation and then moving to the higher pastures as the season progresses. The sensitive areas of the two major drainages have been fenced into riparian pasture.

Crane/Kelly allotment (A036) is currently managed as a two pasture rest rotation system on the two pastures where the grazing activities impact the habitat of the Warner sucker. These two pastures consist of 8,595 acres. The total allotment consists of 20,830 acres and is permitted for 263 cow/calf pairs for a season of 6/25 to 10/14 on four pastures under FRES strategy C. On the pastures in Warner sucker habitat and within the Deep Creek watershed, 160 pair graze one pasture for approximately eight weeks, then are moved either to the pastures out of the habitat area or on to adjacent private land. This allotment has two areas fenced into riparian pastures for protection and controlled livestock use.

Crane Mountain allotment (A037) consists of 7,462 acres and is currently managed under FRES strategy B as a two pasture deferred rotation system for 150 cow/calf pairs under a term and 20 pair under a private land permit for a permitted season of 8/1 to 10/15. The deferred use on each pasture is scheduled for two years at a time.

Horse Prairie (A046) is a three pasture allotment. The Hickey Pasture contains 3,153 acres and is currently managed as an early season system by nine term and 49 private land permitted cow/calf pairs under a season from 7/16 to 8/30. This pasture has no sources of live water. Stock water is provided by depressions filled from snowmelt and rain. The other two pastures contain 8,455 acres plus 561 acres in two riparian pastures and are currently managed as a two pasture deferred rotation system for 326 cow/calf pairs permitted from 8/1 to 9/30. The entire allotment is managed under FRES strategy C.

Little Cove allotment (A049) contains 2,297 acres and is currently managed under FRES strategy B as a season long system for 150 cow/calf pairs under a permitted season 6/16 to 8/15. For the last couple of years though, the season has been 7/16 to 9/15. The cattle are split with one half going to the west area of the allotment and the other half going to the east area. The east area is where grazing impacts Warner sucker habitat. It has been determined this action may affect, but is likely to not adversely affect sucker habitat and therefore only 20% of the pastures will be monitored on an annual basis. In 1997 a pothole was blasted on the east side of Bull Prairie to collect surface water for livestock use to aid distribution. Also, a spring located farther west was developed and fenced for protection and the water piped to a trough.

McDowell allotment (A050) contains 5,299 acres and is currently managed under FRES strategy B as a season long system under a permitted season of 7/6 to 8/20 for 63 cow/calf pairs. For at least the last two years, planned use has been 32 cow/calf pairs from 6/30 to 9/11 and 45 yearlings 6/23 to 9/9. Reported actual use has been less than this in length of season and numbers.

Porcupine allotment (A052) contains 7,720 acres and is currently managed under FRES strategy C as a two pasture deferred rotation system under a permitted season of 7/1 to 9/30 for 200 cow/calf pairs. Only the east or the Porcupine unit is included in the consultation of grazing impacts on the Warner sucker. 1997 was the first year the allotment was grazed since 1991. The permit was acquired by a new operator.

Rogger Peak allotment (A053) contains 10,085 acres and is currently managed under FRES strategy C as a two pasture deferred rotation system under a term permitted season of 8/1 to 10/15 for 335 cow/calf pairs and a private land permit for 17 cow/calf pairs from 8/15 to 10/14.

Squaw Butte allotment (A055) contains 4,845 acres and is currently managed under FRES strategy B by two permittees under the provisions of on/off and private land permits. One on/off permit is for 53 cow/calf pairs from 7/16 to 9/30. The other such permit is for 24 cow/calf pairs from 7/16 to 11/30. The private land permit is for 32 cow/calf pairs from 7/16 to 9/30. Maintaining the on/off permits is contingent upon retaining control of the private lands which is owned by Fremont Sawmill.

C. Cultural Plants

Plants in the watershed have been used by Fort Bidwell Paiute and their ancestors. References are made by Isabel Kelley (1932) about the following plants. Locations have been verified by the BLM botanist. Tobacco root (Valeriana edulis) is found in Big Valley and wet meadows; camas (Camassia quamash) in Big Valley, Camas Valley and other creeks and meadows; epos (Perideridia gairdneri) and biscuit root (Lomatium canbyi) in lithic soils and scabland. Wild onions, bitterroot, sego lily, chokecherry, Indian plum and balsamroot were all collected and still grow within the watershed.

Resources of native food plants appear to be in good condition.

D. Administration

Forest Service guard stations were previously located within the watershed. These were removed during the 1970s, either destroyed by fire or dismantled. They were not replaced and Forest Service management is now accomplished out of the central district office.

E. Recreation

Camping occurs within rustic forest camps (Dismal, Deep and Willow Creeks, Twin Springs and Mud Creek). Dispersed camping is done in general forest areas. Hiking, horseback riding, mountain bike riding and off-highway vehicle riding takes place along the Fremont National Forest Recreation Trail (NRT) and the Crane Mountain National Recreation Trail, which are accessed at Walker, Rogger and Crane trailheads. Two semiprimitive motorized areas, Crane Mountain and Mt. Bidwell, offer additional off-highway vehicle recreational opportunity (Map 3). Forest Service roads 3615, 3915 and 3910 are the main snowmobile trails with some loop roads incorporated on an annual basis (depending on snow depth).

Aspen Cabin is available for rent from June through October and is also used as a winter warming cabin for snowmobilers and other winter recreationists.

On the lower reaches of the watershed, major recreation activities include but are not limited to stream and reservoir fishing, hunting, camping and ATV use. This use is low and dispersed and there are no designated or developed recreational sites or trails. Camping and ATV use increase during the fall hunting season. Roads in the area are rough and not maintained, but offer good four-wheel-drive access to the area. Most of the lower reaches are open to motorized vehicles, except the Fish Creek Wilderness Study Area (Map 3), where vehicles are restricted to existing ways and trails. Most recreational use occurs along Oregon State Highway 140 which parallels Deep Creek. Travellers commonly stop at Deep Creek Falls and at several other pulloffs to stretch and fish. One commercial permit to allow guided fly fishing trips on Camas, Deep and Drake Creeks is in the process of being issued. There are no other known commercial recreational activities in the watershed.

F. Archaeology

The area contains large numbers of archaeological sites. These include lithic scatters, occupation sites, stone tool material quarrys, vision quest sites and other religious sites. These sites are in some instances being impacted by livestock grazing at water locations. Some sites are being impacted by the activities of artifact collectors.

G. Wild and Scenic River

A preliminary eligibility determination report for Deep Creek was completed in 1996. The segment on the Fremont National Forest was found eligible for further study. The creek was found free flowing and fishery values outstandingly remarkable. The lower reach of Deep Creek on BLM-administered land was found not to meet the eligibility criteria established by Congress in the National Wild and Scenic River Act.

STEP 4. REFERENCE CONDITIONS

The purpose of Step 4 is to describe the area's known or inferred history prior to recent human influence and natural disturbances. This helps the core team understand what existed in the past and what changes have occurred that may affect current capabilities. Reference conditions are compared with current conditions over the period that the system evolved. The reference conditions step is based on the premise that ecosystems adapt over extended time periods and that the greatest probability for maintaining future sustainability is through management designed to maintain or reproduce natural components, structures and processes. Reference conditions are divided into presettlement and historical time periods. Historical refers to the time period from about 1870 to 1945 and presettlement for the time period prior to 1870.

Erosion Processes

During the presettlement period, soils eroded at very low rates for the most part because management-induced factors contributing to accelerated erosion did not exist. Erosion under these conditions is termed natural or geologic. Soils had lower bulk densities and higher infiltration rates. Water infiltrated the soil to a higher degree and/or flowed naturally over the soil surface without being intercepted, collected and concentrated by roads or irrigation ditches. Soil compaction and displacement did not exist, or only to a minor extent.

Mass wasting was a rare occurrence. It was primarily related to geologic faulting and initial mountain building where steep and unstable slopes were created. Both of these events reduced the natural stability of hillslopes and resulted in rotational slumping or debris avalanches depending on soil/bedrock characteristics. It may also have been related to natural catastrophic events such as unusually intense wildfires followed by intense storms or rain on snow events. This mass wasting occurred over extremely long periods of time and resulted in localized high levels of erosion for several years.

Soil conditions within riparian zones had bulk densities that were low and typically had water tables that were higher than at present. This contributed to lush vegetative growth and stable stream banks.

Natural soil erosion rates are similar to erosion rates in the Dairy/Elder and South Creek watershed (Schumm and Harvey 1982 cited in Fremont National Forest 1998). They are highly variable and range from essentially zero to an average maximum of one mm/yr. One mm/yr equates to about five tons/ac/yr. This could occur under the most extreme natural conditions such as those resulting from a severe intensity wildfire. Generally, losses were much lower and are estimated to have averaged less than 0.5 tons/ac/yr. This estimate is based on climatic conditions as well as physical and chemical weathering from bedrock or consolidated deposits over bedrock. Few soils are produced by bedrock weathering at annual rates greater than one ton/ac (Alexander 1988 cited in Fremont National Forest 1998).

On ponderosa pine sites, low intensity wildfires generally burned at intervals of about 25 to 75 years. These were caused by lightning or were set by aboriginal people or homesteaders to enhance the area for hunting, gathering, livestock grazing or land clearing. Generally, these low intensity fires had minimal impact on the soil surface and erosion rates were not increased to a significant extent. Occasionally, weather conditions would have permitted higher intensity fires to occur which would have removed variable amounts of organic matter on site and exposed the mineral soil surface to erosional forces. Estimated soil loss rates per acre relating to fire within the major soil groups are shown in Table 36. The calculations were based on a Guide for Predicting Sediment Yields From Forested Watersheds (1981). The figures represent the first year erosion rates following a moderately intense wildfire.

Moderate burns are defined as fires that char the litter or duff but do not alter the underlying mineral soil and consume between 40 and 80% of the plant canopy (Effects of Fire on Soil 1979). The erosion rates shown in the table would be much higher after a severe fire. Severe fires were not a common occurrence.

Table 36. Estimated Erosion Rates Relating to Moderately Intense Wildfire (Tons-1st yr)

Parent Material	Basic Erosion Rate	Geologic Erosion Factor	Erosion Rate
Basalt/And/Tuff	550 t/sq.mi.	.42	0.4 t/ac
Pyro/Tuff Sed	550 t/sq.mi.	.66	0.6 t/ac
Rhyolite	550 t/sq.mi.	1.00	0.8 t/ac
Alluvium	550 t/sq.mi.	1.05	0.9 t/ac
Ash/Pumice	550 t/sq.mi.	.35	0.3 t/ac

Increased erosion rates would have occurred for about four years after the fire and then returned to natural levels by year five. Soil losses the first two years are estimated to be the most significant. Losses during the third and fourth year would be only slightly above the geologic rate due to natural reestablishment of vegetation.

The natural landscape began to change with the advent of settlement which began in the mid to late 1800s. The first white inhabitants had minimal effect on the land as the primary interests were trapping and exploring. The first major impacts were logging and grazing by large herds of sheep. Records indicate that 125,000 cattle months and 463,000 sheep months utilized the Fremont National Forest during the peak grazing years of 1909 and 1910. It is assumed that the Deep Creek watershed received comparable grazing intensity. These impacts, along with associated road building necessary to access timber, began the changes to the landscape which resulted in accelerated erosion. Stream bank erosion was accelerated primarily by a very high grazing intensity, while upland erosion was accelerated by a combination of increased logging, road building and grazing.

Hydrology

A. Base Flow

Low flows that occurred in reference conditions are unknown. Early stream gauge information from the Deep Creek gauging station cannot be used for comparison, because much of the water above the gauging station was diverted during the low flow period for irrigation purposes, and gauging records do not exist prior to this use. Gauging records show that there is always some flow in Deep Creek at the gauging station. During a Wild and Scenic River review in August 1992, monitoring showed the creek was dry between Limburger Cabin and Camas Creek. It became perennial again at the confluence of Camas Creek. The reference condition of this dry reach is unknown due to changes in the hydrology of Big Valley. It should be noted that 1992 was a low flow year and the status of this reach during normal flow years is unknown.

Lower elevation streams in alluvial depositional areas generally had higher water tables than today and riparian vegetation typically occupied the entire width of the valley bottom. Also, beaver populations were higher prior to trapping that started in the 1800s, particularly in low gradient areas. Beaver dams were more prevalent and helped to maintain the water table. Base flows were enhanced because water was impounded by the dams during spring runoff in adjacent alluvium and released through seepage into the stream channel during low flow periods. Therefore, reference base flows were most likely higher in the Deep Creek watershed below these riparian areas. The magnitude of this change is unknown.

Generally, the high elevation streams were stable and had water tables near the surface. Similar conditions exist in current conditions. Base flows would have changed very little from downcutting at higher elevation areas of the forest due to the naturally rocky substrate of the stream channels and its high resistance to erosion. Low gradient streams were sinuous and had water tables near the surface. Base flows would have been greater in these areas historically, where downcutting has occurred.

Lentic systems are standing water habitat such as lakes, ponds, seeps, bogs and meadows. The large expanse of alluvial deposition shown on Map 4 in the Appendix was most likely meadow area in reference conditions. The historic conditions are unknown, but it is assumed that these areas generally had a high water table with large expanses of willow and beaver populations.

Presently, higher leaf area of white fir and conifer/juniper encroachment in meadow areas has resulted in higher evapotranspiration rates throughout the watershed. This indicates that base flow would have been higher in reference conditions because less evapotranspiration would have occurred. New openings from clearcuts have made little change in the overall openings in the watershed. Also, it is not known if low elevation forest stands were fully occupied due to frequent fires. Stands that were not fully occupied historically would have had excess water available for base flows.

B. Mean Flow

Mean flows in streams are highly variable. Comparison of mean daily flows from the Deep Creek gauging site near Adel, Oregon shows no significant trend in mean daily flows (See Current Conditions-6).

C. Peak Flow

Analysis shows that flows that exceed bankfull (peak flows) occurred less often in reference conditions (Figure 2).

Vegetation

A. Upland (Forest) Vegetation

1. General Description

The historic range of variability of upland forest vegetation on the Fremont National Forest included three major forested types: ponderosa pine, pine associated (mixed conifer consisting primarily of white fir and ponderosa pine) and lodgepole pine. This watershed also has subalpine stands at the upper elevations of Crane Mountain and juniper woodlands in the southeastern portion of the watershed where moisture is a limiting factor for coniferous growth.

Table 37 provides an estimate of the proportion of ponderosa pine, pine associated and lodgepole pine by seral stage during the reference period.

Table 37. Forest-wide Estimates of Ponderosa Pine, Pine Associated and Lodgepole Pine by Structural Condition

	Pine	Pine Associated	Lodgepole Pine
Old	60-80%	40-70%	
Low-productivity			1-3%
High-productivity			1-5%
Late	10-30%	40-70%	50-10%
Mid	5-10%	20-40%	10-30%
Early	1-5%	10-30%	30-90%

Table 38. Canopy Cover (Reference Conditions)*

Cover Group	Acres	% of Area
Nonforest	98,296	55
Shrubs	(1)	0
< 25%	49,208	28
26-55%	24,722	14
56-70%	5,218	3
71+%	508	<1

*Data from Klamath/Lake County 1947 timber type maps. This data is the oldest set available but represents stands mid way in the present twentieth century fire suppression regime.

(1) Shrub data was not separated from nonforest data in this set.

The 1947 timber type GIS coverage for Lake County was utilized to characterize and estimate the historical structural stage and canopy cover for the Deep Creek watershed. The 1947 data was used for a snapshot of structural stage because little harvest activity occurred before this time and no earlier information was available on forest cover. However, it would not reflect conditions prior to intensive grazing which occurred between 1870 and the late 1930s. Also, there could be considerable change in vegetation from almost forty years of fire suppression.

This snapshot must be viewed with caution when it is used to compare current with reference conditions. Structural stage and canopy vary with disturbance cycles and move across the landscape at any point in time. Tables 37 and 38 attempt to display the relative percentage of structural stage and canopy cover condition. Structural stage is generally defined as the age of a stand as expressed in four major groups. Early structural stage is the period of a stand's beginning and is usually seedlings and saplings. The mid stage represents a period during which the stand is growing and the canopy is rapidly closing. It is represented by the terms post and poles. The late stage is when the stand has reached maturity, the canopy has closed and some large old trees characterize the overstory. It is represented by small to large saw timber. The old stage is the time when a stand has large old tree character and begins to develop layers and structure. It is represented by large mature trees that are reaching advanced senility. The stand is regenerating again in smaller patches while retaining the structured layers. Species tend to shift toward more shade tolerant species such as true firs.

a) Ponderosa Pine

Ponderosa pine was historically maintained by frequent, low intensity disturbances in the form of ground fires on a return cycle of 25 to 75 years and insect attacks. Low intensity fires consumed the litter fall and low vegetation. Occasionally, small openings ranging between two to five acres were created in the overall large park like stands where a small group of trees would torch out. The result would be areas of natural regeneration that moved continually across the landscape. When stand-replacing fires occurred, the patch size was large, over two hundred acres on average. Insects would affect mostly the large old pine that were succumbing to old age. The western pine beetle (Dendroctonus brevicomis) was active at an endemic level along with most other insects. Large pine under stress from old age or drought were killed on a regular basis. The resultant mosaic of structural stages was one of smaller patches of seedlings/saplings and post/poles moving across the landscape until stand-replacing events occurred. The total extent of these younger stands was low. The large stand-replacing events occurred on a long return interval but resulted in large to extremely large evenaged patches.

Generally, the encroachment of true fir into ponderosa pine is a function of climate and disruption of the natural fire disturbance regime. On the eastern slopes of Crane Mountain the rain shadow effect of orographic lift extends the ponderosa pine to a higher elevation than in other places on the forest. Generally, sites that are classified as a CW ecoclass on this side of the mountain and are under 6,500 feet in elevation were maintained in a more open predominantly large ponderosa pine tree condition (1947 Timber Typing for Lake County, Fremont National Forest GIS coverage). Below 6,000 feet, ponderosa pine probably was dominate. The proportion of white fir in the overstory probably increased with elevation above 6,000 feet. In the northern part of the watershed drained by Camas Creek, the elevation band is lower and ranges around 6,000 feet.

b) Pine Associated

Pine associated was historically maintained by less frequent, but higher intensity disturbances, mostly in the form of insect attack and fire. It appears true fir, or pine associated type as it was classified, would respond to insect outbreaks that would increase as the density of fir increased. When some maximum carrying capacity was reached, there would be significant mortality of true fir from fir engraver and Modoc budworm. The majority of the mortality would most often be in the white fir, resulting in large fluctuations in the relative dominance of that species in the stands. Fires were generally a stand-replacing event that occurred on long return interval of 75+ years. Fires occurring after an extended fire-free period would likely have been more intense and were probably the norm in the higher elevation (>6,500 feet) stands with larger proportions of white fir. Fires typically occurred as scattered events over the landscape.

Insect outbreaks occurred when stocking increased and stand density exceeded the upper management zone of SDI. At this point, the stands were so overstocked that the insect population increased rapidly, creating a population explosion. The insect population would follow drought cycles. After drought weakened tree defenses and insect populations increased, white fir mortality increased quickly from fir engraver. Modoc budworm populations are prolific defoliators but do not cause a great deal of mortality during an outbreak. They cause significant growth loss from top kill. The population would rise and fall as the naturally occurring virus that kills the budworm rose shortly after the population increased.

A large fire would likely occur after increased mortality from fir engraver when the dead fuel load dramatically increased. The variability of the frequency and intensity of fire disturbances resulted in a wide range of structural conditions that were maintained for long time periods. Late and old structural conditions could persist as scattered, large blocks for several hundred years.

c) Lodgepole Pine

Lodgepole pine was historically maintained by frequent intense disturbances typified by insect outbreaks followed by a high intensity stand-replacing fire. Lodgepole pine is not as prevalent in this watershed but still occurred in large almost pure stands. At the point where stands reached the state of having late or old structural characteristics, they would become stressed by overstocking and slow growth. They became susceptible to insect attack usually by mountain pine beetle (Dendroctonu ponderosae) followed by a fire. When a stand-replacing event happened, it would consume very large patches. The results would be some remnant trees and small clumps that would provide seed for natural regeneration of large blocks of evenaged trees.

d) Juniper

Western juniper has been part of the landscape of eastern Oregon for thousands of years. Presettlement juniper was considerably less abundant and primarily confined to rocky surfaces or ridges and low sagebrush table lands. Junipers began to expand their range aggressively in this region during the late 1800s (Young and Evans 1981, Eddleman 1987, Miller and Rose 1995). Prior to 1875 fire probably played a major role in limiting juniper distribution. The majority of present day juniper woodlands are less than 100 years old (USDI BLM 1990).

Government Land Office Notes from 1880 for the Chewaucan River drainage on National Forest System land mention little or no juniper presence. In 1895, surveyors described juniper on many occasions as "undergrowth", documenting the early stages of juniper encroachment. Miller (1997) found juniper initiated expansion between 1875 and 1885 in the Chewaucan River Basin. Rate of expansion peaked between 1905-15. Severe drought conditions slowed expansion from 1935-45.

B. Rangeland

The vegetation that was present in presettlement times (1870) is still present today but its composition has changed over time. During presettlement the primary method of disturbance was wildfires. The fire interval for mountain big sagebrush in the intermountain region is 12-25 years (Miller 1998). Fires would remove all the vegetation giving the grass and herbaceous vegetation an advantage for a period of years before the woody species could become established. A mosaic of vegetation types existed with the frequency of fire, either natural or man caused, determining the dominant vegetation in space and time.

With the introduction of livestock around 1870, grazing became the primary means for disturbing vegetation. Grazing removed the fine fuels (grass and forbs) and reduced the chance of fire ignition and spread. This combined with active fire suppression reduced the number and size of fires. The result of this change in fire regime on big sagebrush communities was that the size and amount of big sagebrush increased and the density of juniper increased. The more open grass dominated areas decreased.

Herbaceous understory vegetation has been effected not only by the increase in shrubs and junipers but also by livestock grazing. In the early 1900s, there was no regulation on the number or type of livestock grazing on public land and the result was excessive grazing by cattle, sheep and horses, especially in areas near water sources. This grazing pressure reduced native grasses such as Idaho fescue and bluebunch wheatgrass and allowed to establish and spread introduced species such as Kentucky bluegrass and cheatgrass. Since the early 1940s, the number and type of livestock on public lands has been greatly reduced. This change in management has helped stabilize the plant community and the result is a wide variety of understory grasses, including both desirable and undesirable species.

C. Noxious Weeds

The Forest plan defines noxious weeds as "Undesirable plant species that are unwholesome to the range or to animals" (p. 22). Undesirable and unwholesome are terms that are generally associated with the coming of Euroamerican settlement and grazing of the western range lands. Plants may have existed in the watershed that were unwholesome to animals prior to this time, but it is assumed that they coexisted in the environment within some natural range of variability in response to disturbance. Most noxious weeds are exotic to the reference condition.

Mediterranean sage was probably the first noxious weed in the watershed and it came approximately fifty years ago. Other weeds have come in since then and some in the last five to 10 years.

D. Riparian Vegetation

Little information is available on the presettlement or historical condition of riparian vegetation. Conversations with long time, local residents suggest that riparian zones had a significant black cottonwood component and aspen was much more common. Many of the natural stream courses had a large willow component also.

Riparian vegetation in alluvial meadow areas was historically a willow/beaked sedge association (USDA 1987). This association was probably characterized by the following conditions.

Potential natural vegetation: A sward of beaked sedge occurs under a canopy of Geyer or Booth willow (Geyer willow is found in this watershed). Nebraska sedge and Baltic rush increase in cover on disturbed sites. Tufted hairgrass is present on many plots but is very subordinate to sedges.

Table 39. Floristic Characteristics

Dominants	Range % Canopy Cover	Mean Canopy Cover
Geyer Willow	0-37	15
Tufted hairgrass	0-15	5
Beaked Sedge	0-87	44
Shrubs		
(Mountain alder and Geyer willow)	25-90	49
Grasses	1-15	7
Sedges	37-90	61
Forbs	15-30	19

Estimated herbage production ranged from 400 to 4,000 lbs/acre dry weight. Beaked sedge is moderately palatable to livestock in late summer. With overuse by livestock, other graminoides and forbs become codominant with beaked sedge.

Field review by Mike Montgomery (1998) identified that mature willow populations in the large meadow areas of the watershed appear to be dominant. Single sprouts and young willows (less than 10 stems) are found less frequently along stream reaches in the meadow areas. However, historic photos show that the overall amount of willows in meadows has increased in the last 30 years. The existing and historic levels of willow have not been quantified, however it is estimated that canopy cover is somewhat below the potential natural levels. Disturbed soil areas along the greenline (six foot riparian area adjacent to the stream channel) are the primary locations where sprouts and young willow become established. As identified above, it is estimated that the potential shrub canopy cover is in the range of 25 to 90% with a mean value of 49%.

Note: Willow will generally not develop on very low gradient streams where cutting action and deposition does not occur. Instead, they will develop as a result of episodic events that cut and scour the channel. The Riparian Ecosystem Classification Project will identify areas that are capable of supporting willow. This will be more site specific than the Riparian Zone Association Guide provided by Kovalchick (1987).

Riparian areas were heavily grazed from about 1870-1940. Many of the riparian areas were downcut especially near the turn of the century before there was any control of livestock. For a description of the effects of this uncontrolled livestock grazing on riparian areas refer to Synthesis and Interpretation-4.

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E. Threatened, Endangered and Sensitive Plant Species

Prior to 1870 (presettlement), ecological processes were considered stable or at least cyclic and functioning within some range of natural variation. Plants became extinct in response to naturally occurring disturbances and change. Therefore, by definition, there were no threatened, endangered or sensitive species occurring as a result of human management activities.

Listed sensitive plants were present in historic times but to what extent is not well documented. The disturbances from grazing, road building, logging, irrigation and water diversions have altered the vegetation community throughout the watershed. Therefore, it could be assumed these listed plants have been affected but to what extent is not known. Cultural plants were also present and collected in presettlement and historic times and have been impacted by the disturbances listed above. Again, the extent of the impacts is not well documented.

Stream Channel

A. General Discussion

Stream habitat features of pools per mile, large pools, large woody debris, bank stability and fine sediment in spawning substrate are the standards by which stream channels are evaluated in this analysis. These parameters are quantified in the Evaluation of the EIS Alternatives by the Science Integration Team for the Interior Columbia Basin Ecosystem Management Project (ICBEMP 1998). Table 40 summarizes the 50th and 75th percentile for natural and near natural stream data for streams in the northern Great Basin (ERU4).

Table 40. Natural and Near Natural Stream Data

Slope Class	Large Pools Per Mile		Pools Per Mile		Large Wood Per Mile	
	50th	75th	50th	75th	50th	75th
All	0.000	0.003	0.027	0.049	0.019	0.062
<2%	0.000	0.005	0.027	0.053	0.006	0.025
2-4%	0.001	0.004	0.029	0.044	0.020	0.085
>4%	0.000	0.000	0.030	0.051	0.020	0.067

Large pool frequency is the number of pools with a maximum depth greater than 2.6 feet. Large wood is determined using wood that is 20" in diameter on the small end and >35 feet long. The natural or near natural frequency is determined using the above table and the formula number per mile = table value x 5280/average riffle width in feet.

Other evaluation criteria include fine sediment and stream temperature. Fine sediment is determined to be excessive when >30% fine sediment (6.4mm) is in the top four inches of potential spawning substrate material. The maximum water temperature is 17.8ºC using the 7-day moving average of daily maximum temperature.

Reference conditions by stream reach are provided below. These were developed using Table 40 for natural or near natural conditions.

Table 41. Reference Conditions by Stream Reach

Stream Reach	Mean Riffle Width Ft.	Gradient %	Pools >2.6 Ft. 50th	Pools >2.6 Ft. 75th	Pools per Mile 50th	Pools per Mile 75th	Large Wood per Mile 50th	Large Wood per Mile 75th
Mud Creek Subshed (01)								
Mud Creek								
1	14	6	0	0	11	19	8	25
2	6	1	0	4	24	47	5	22
Lower Camas Creek Subshed (02)								
Camas Creek								
1(BLM)	27	2.5	.2	.8	6	9	4	17
2(BLM)	24	0.2	0	1	6	12	1	6
3(BLM)	33	3.0	.2	.6	5	7	3	14
Horse Creek Subshed (03)								
Horse Creek								
1	10	5	0	0	16	27	11	35
5	15	5	0	0	11	18	7	24
Burnt Creek Subshed (04)								
Burnt Creek								
2	1	4	.5	2	14	21	10	41
3	9	12	0	0	18	30	12	39
4	10	2	.5	2	15	23	11	45
6	6	1	0	4	24	47	5	22
8	6	5	0	0	26	45	18	59
9	5	1	0	5	29	56	6	26
Upper Deep Creek Subshed (06)								
Deep Creek, South Fork								
1	8	7	0	0	20	34	13	44
2	8	9	0	0	20	34	13	44
3	7	10	0	0	23	39	15	51
Deep Creek, Middle Fork								
1	23	2	.2	.9	7	10	5	20
2	22	4	2	7	51	77	35	150
3	18	5	0	0	9	15	6	20
4	17	2	.3	1	9	13	6	25
5	8	8	0	0	20	34	13	44
6	7	19	0	0	23	39	15	51
Deep Creek, North Fork								
1	13	8	0	0	12	21	8	27

Stream Reach	Mean Riffle Width Ft.	Gradient %	Pools >2.6 Ft. 50th	Pools >2.6 Ft. 75th	Pools per Mile 50th	Pools per Mile 75th	Large Wood per Mile 50th	Large Wood per Mile 75th
Mosquito Creek								
1	9	5	0	0	18	30	12	39
2	10	16	0	0	16	27	11	35
3	5	4	1	4	31	47	21	89
4	6	10	0	0	26	45	18	59
<u>Dismal Creek Subshed (07)</u>								
Dismal Creek								
2	14	7	0	0	11	19	8	25
3	9	2	.6	2	17	26	12	50
<u>Willow Creek Subshed (08)</u>								
Polander Creek								
2	7	4	.8	3	22	33	15	64
3	7	10	0	0	23	39	15	51
Willow Creek								
1	7	3	.8	3	22	33	15	64
2	7	4	.8	3	22	33	15	64
3	7	1	0	4	20	40	5	19
4	10	1	0	3	14	28	3	13
6	6	11	0	0	26	45	18	59
7	4	4	1	5	38	58	26	112
8	5	20	0	0	32	54	21	71
9	4	9	0	0	40	67	26	88
<u>Lower Deep Creek Subshed (11)</u>								
Lower Deep Creek								
5(BLM)	21	2.3	.3	1	7	11	5	21
6(BLM)	26	0.5	0	1	6	11	1	5
<u>Peddlers Creek Subshed (13)</u>								
Parsnip Creek								
1(BLM)	5	2.0	1	4	31	47	21	90
2(BLM)	3	1.3	0	9	48	93	11	44
3(BLM)	5	2.0	1	4	31	47	21	90
4(BLM)	8	2.0	.7	3	19	29	13	56
5(BLM)	10	9.0	0	0	16	27	11	35
<u>Drake Creek Subshed (14)</u>								
Drake Creek								
1(BLM)	22	1.0	0	1	7	13	1	6
2(BLM)	26	1.0	0	1	6	11	1	5
3(BLM)	18	1.0	0	2	8	16	2	7
4(BLM)	22	2.5	.2	1	7	11	5	20
5(BLM)	20	2.5	.3	1	8	12	5	22

Stream Reach	Mean Riffle Width Ft.	Gradient %	Pools >2.6 Ft. 50th	75th	Pools per Mile 50th	75th	Large Wood per Mile 50th	75th
6(BLM)	6	1.4	0	4	24	47	5	22
Roaring Spring Fork								
1(BLM)	12	1.3	0	2	12	23	3	11
2(BLM)	16	1.2	0	2	9	18	2	8
Gibson Canyon Subshed (15)								
1(BLM)	43	2.4	.1	.5	4	5	3	10
2(BLM)	41	1.4	0	.6	4	7	.8	3
3(BLM)	37	0.6	0	.7	4	8	.9	4
4(BLM)	32	1.7	0	.8	5	9	1	4

B. Geomorphology

Stream morphology varies with respect to geology and valley shape. Streams show similar characteristics depending on location within the watershed. Historically, there were at least three distinct geomorphic features. Geomorphic descriptions that apply to this watershed are obtained from descriptions of similar systems (Rosgen 1996).

1. Valley Floor

Generally, low gradient streams are found in the lower portions of the watershed. These streams had reference conditions of Rosgen type C or E channels. Gradients were less than 2% and were characterized by well developed alluvium floodplains. Stream channels had moderate to high sinuosity with gravel size bed materials. Large open meadow areas had little large wood and were characterized by aquatic sedge species and willow. As the valley floor became steeper, the tendency was for stream channels to become less sinuous and move from E to C type channels. Aquatic sedges, willow, aspen and cottonwood were more common along these areas. Large wood material increased as the stream gradient increased.

2. Narrow Valley/Colluvial Slopes

As stream gradients increased to the range of two to four percent, streams were characterized by Rosgen type B channels. The bed material consisted of gravel material with the channel characterized by a series of rapids with irregular shaped scour pools. Channels were relatively stable and did not contribute a high sediment supply to the stream. Large woody debris was an important component of these streams.

3. Lateral Tributary and Headwaters

These were stream channels that had gradients greater than four percent, were steep, deeply entrenched, with confined channels and coarse depositional materials. These met the Rosgen type A channel conditions. These channels were step/pool or cascading channels, often influenced by organic woody debris that formed debris dams behind which was stored significant amounts of sediment in the pools.

Other factors affecting geomorphology

Beaver dams had a large influence on streams. Beaver dams helped to trap sediment, raise the water table, increase flows throughout the low flow period of the year and influenced aquatic vegetation adjacent to the stream.

Water Quality

A. Fine Sediment

Fine sediment in the stream substrate influences the development and emergence of fry. Successful fry emergence is hindered by excessive amounts of sand and silt in the substrate. General habitat guidelines for incubation of salmonid embryos require less than 25% by volume of fines < 6.4 mm (Reiser and Bjornn 1979). Surface fines less than 20% in spawning substrate are the recommended level in the ICBEMP.

Sieve analysis of potential spawning substrate has been conducted forest-wide in a broad range of geologic types. The ideal 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 National Forest. Few sample areas have fine sediment in quantities greater than 30%. Using this forest-wide analysis, and above recommendations, fines less than 20-30% would be considered reference condition.

B. Water Temperature

The Oregon Department of Environmental Quality (ODEQ) criteria is to have a rolling 7 day maximum average at or below 17.8ºC. Stream temperatures under historic conditions are unknown. Presently, there are no reference reaches that provide a basis for determining attainable stream temperatures.

Historic management has resulted in changed physical stream channel features and vegetative shading. Historically, many reaches had higher levels of shading from willows, trees and herbaceous vegetation. Also, narrower and deeper stream channels provided higher levels of shading. Nearly every reach has been affected by at least one factor that produces higher stream temperatures. Thus, it is assumed that stream temperatures were lower historically than they are today.

Even though temperatures were probably lower than present, it is not known if State of Oregon standards were achieved in all streams. The effects of beaver dams, exposed water in flooded areas and natural openings in meadows may have resulted in historic temperatures that were above current State standards. The Silver Creek Watershed Analysis showed that the Silver Creek Marsh had temperatures that met State standards when the stream entered the marsh, but exceeded State standards when it left the pristine marsh area.

C. Macroinvertebrates

For macroinvertebrates, reference conditions of good to excellent would indicate optimum water quality and habitat for trout species.

Species and Habitats

A. Terrestrial

1. Threatened, Endangered, and Sensitive Species

a) Northern Bald Eagle (Threatened)

There is no historic information for northern bald eagle habitat or numbers and distribution for the period prior to 1945. Nest/roost habitat was probably more abundant on the forest during this period with higher large tree density, and bald eagle use was probably higher due to the potentially greater prey base (cyclic waterfowl abundances), low road densities and a lower incidence of human use.

b) American Peregrine Falcon (Endangered)

Although peregrine falcons were never studied in southeastern Oregon in depth prior to studies conducted by the Wilderness Research Institute in 1982, peregrines probably nested in Warner Valley during the Pleistocene because the climatic conditions promoted a favorable prey base. During this period ducks and geese flourished along with a variety of other potential prey.

No historical nest sites are known for the watershed. The only historic data for peregrine falcon use comes from anecdotal evidence cited by the Wilderness Research Institute (Boyce and White 1982) which reported that historical accounts from the last 100 years documented several records of nesting peregrines in eastern Oregon. Benjamin Bonneville observed peregrines at Warner Lakes and Morlan Nelson claimed that they nested from Adel north along Fish Creek Rim as late as 1948.

Nesting habitat quantity and quality were probably very similar to what appears today on Fish Creek Rim. Greater waterfowl abundance provided a better prey base. Habitat for prey species and hunting within the forested portion of the watershed was only fair to marginal because the landscape was dominated by forest canopy. Habitat security was probably much greater during the period because road densities, recreational use and logging activity were low.

It has been concluded that climatic changes and pesticide application (causing egg shell thinning) were the major factors contributing to the peregrine decline in southeastern Oregon, as well as the rest of the United States.

c) Western Sage Grouse

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 from 1938-1941 when between 400 and 1,600 grouse were estimated to occur on the forest.

In general, the suitability of grouse habitat and grouse numbers most likely gradually declined from 1870-1945 because of human settlement and heavy livestock use on uplands and riparian areas. The cumulative effect of high deer numbers in lower elevation shrublands around 1930-60 exacerbated the decline of habitat conditions for sage grouse. Large numbers of grouse also were probably harvested by early settlers.

d) California Bighorn Sheep

No presettlement or historic data on California bighorn sheep occupancy exists. However, American Indian rock art in the area depicts representations of bighorn sheep and it is believed that bighorns occupied the area during this period. Habitat conditions were probably pristine during the early portion of this time period. However, with the onset of Euroamerican settlement, native bunchgrass communities were immediately altered by the introduction of domestic sheep grazing. Severe overgrazing by domestic livestock from about 1880-1940 probably reduced habitat suitability for bighorns. Less suitable habitat conditions and disease transmission from domestic sheep probably reduced bighorn numbers and distribution.

2. Keystone Species

a) Big Game

Accounts from the journals of John C. Fremont (1846) read that deer were small in numbers and that elk were very rare occurrences. Other historical accounts of the Warner mule deer herds describe herds as small and scattered in the early 1900s. In the late 1930s, the Big Lake wintering herd was estimated at 2,000 animals. After approximately 1930, deer numbers for both herds began to increase until range damage by deer was noted in the mid 1940s. Estimates for numbers of deer in 1944 were 4,000 for the Big Lake wintering herd. Herd numbers peaked in the 1960s. Reasons for the increase are not clear-cut, but factors contributing probably include predator reductions, decreases in animal user months for sheep and cattle, weather variations, protection from hunting and shifts in the fire cycle on summer ranges.

Seasonal distribution of deer was most likely similar to what occurs today as deer traditionally use the same seasonal ranges over time. Snow conditions generally control the elevational distribution of deer spring, fall and winter.

Prior to 1870, deer ranges at low elevations and on south-facing slopes were probably dominated by bunchgrasses with scattered shrubs because of the high recurring frequency of natural low intensity wildfires. Distribution and density of both bitterbrush and curl-leaf mountain mahogany were probably less than what they are currently. Heavy livestock grazing (beginning around 1870) and later fire suppression combined to gradually increase shrub densities on all seasonal ranges. Consequently, browse conditions on winter ranges increased in quantity and quality. By the 1930s and 1940s, however, deer numbers that exceeded carrying capacity on most ranges began to degrade forage conditions. Poor forage conditions on game ranges were noted in early 1940s.

Hiding cover prior to 1870 was probably adequate in most areas above 6,000 feet elevation, and poor over much of the summer range below 6,000 since these areas were dominated by more open ponderosa pine stands. Fire suppression during the twentieth century has led to dense stands of mixed conifer, which increased hiding cover acres.

No assessment information was available on historic elk population numbers or seasonal distribution in the watershed. Annual wildlife reports for the Fremont National Forest between 1926-1933 showed no elk present on the forest, and only 10 present for the period 1943-1945. Up until 1980, elk numbers in Lake County were too few to consider any recreational hunting seasons.

b) Beaver

No assessment of beaver populations prior to 1935 was available, however, beaver were probably more abundant prior to the arrival of settlers. Records show that beaver were transplanted in eight different locations within the watershed between 1937 and 1940. At the same time, native beaver populations were known to exist along Camas, Dismal and Deep Creeks. It can be surmised that heavy livestock grazing from as early as 1870 through 1945 had adverse effects on habitat conditions. Beaver habitat quality and quantity probably declined. Also, trapping activity, which undoubtedly increased in the late 1800s, had a negative impact on beaver populations.

c) Nongame Species

No nongame or neotropical bird assessments are available for the period prior to 1945. However, species dependent on sagebrush that require maintenance of multi-aged sagebrush stands with a diverse grass and forb understory, as well as, riparian area dependent species probably had more suitable habitat conditions before settlement, the introduction of livestock grazing and fire suppression.

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

There is no designated LOS forest cover on BLM-administered lands within the watershed.

The abundance, distribution, connectivity and quality of suitable habitat for MI and other species associated with dead wood and LOS forest habitats was probably significantly greater during the period 1900-1947 than exists under current conditions (Table 42). The landscape was dominated primarily by large blocks of late/old structure mixed conifer above 6,000 feet elevation, and large diameter ponderosa pine at lower elevations, with breaks created by insect outbreak and stand-replacement fires. Lodgepole pine structure was much more dynamic. Late/old structure lodgepole probably existed only rarely as large areas of lodgepole were constantly broken down by insect outbreaks every 60 years on average and regenerated by stand-replacement fire about every 80 years.

Average, maximum and range of patch sizes in all forest types were large and most of the patches were high quality interior habitat unaffected by edge or roads. Large diameter live trees, snags and down wood were probably more common on average than what exists presently.

Gaps and fragmentation occurred and normally consisted of 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 entire watershed. It is highly probable that because of more abundant suitable habitat conditions for MI and other species, they were more numerous and widely distributed, especially species associated with open ponderosa pine stand conditions. Exceptions may be the pileated woodpecker and American marten, which have probably benefited from the increase in acres of mixed conifer forest.

Table 42. Current and Historic Range of Structural Stage

Timeframe	Early (acres)	Mid (acres)	LOS (acres)
Current	4,515	41,860	30,084
Historic (Low)	5,070	6,950	29,060
Historic (High)	15,350	14,700	48,400

b) Goshawk

There is no goshawk information available for the period prior to 1945.

Nesting habitat suitability was probably higher historically than under current conditions due mainly to more LOS forest habitat and less habitat fragmentation, roading and disturbance during historic times. Small-scale fragmentation provided by early logging around the forest fringes most likely increased home range effectiveness to a point.

c) Pileated Woodpecker (BLM Sensitive and FS MIS)

There is no pileated woodpecker information available for the period prior to 1945.

Pileated habitat prior to the advent of logging in 1947 was highly suitable in areas above 6,000 feet dominated by mixed conifer. Large blocks of mixed conifer LOS with snag and down log components intact were likely prevalent across much of the forested portion of the watershed.

d) American Marten

There is no American marten information available for BLM-administered lands for the period prior to 1945.

Historical accounts of marten on the Fremont National Forest indicate an estimated 300 marten resided within the forest in any given year during the period 1929-1945. Marten habitat suitability was lowest 100 years ago when ponderosa pine stands were dominated by open, park like conditions and lodgepole stands were normally in an early or mid-seral condition at any given time. Within the past 70 years, the increase in acres of pine associated stands has increased habitat effectiveness for this species.

e) Black-backed/Three-toed Woodpecker

There is no black-backed, three-toed woodpecker information available for BLM-administered lands for the period prior to 1945.

Habitat conditions for black-backed and three-toed woodpeckers at the turn of the century were likely less suitable than what exists today. The lack of large blocks of mature lodgepole pine would have created marginal home ranges for this species on a long-term basis. However, periodic large fires that swept through stands of lodgepole pine would have created short-term foraging bonanzas for these birds, and presumably distribution would have shifted relatively often in response to insect, disease and fire disturbance events. Short-term population eruptions undoubtedly followed these large-scale disturbance events.

4. Dead Wood Habitat Management Indicator Species

a) Primary Excavators

There is no primary excavator information available for the BLM-administered lands for the period prior to 1945.

b) Red-naped Sapsucker

No historical information was 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.

B. Aquatic

Historically, perennial streams supported populations of native redband trout and dace. The lower reaches of Deep Creek contained Warner suckers and tui chub in the slower water areas. Both trout and suckers moved up Deep Creek from Crump and Pelican Lakes to spawn.

The redband is a unique subspecies adapted to the Warner environments and habitats. Redband trout constitute a significant percentage of the total fish in the Warner Basin. Throughout the eastern Oregon closed desert basins, fish have adapted over time to live in extremely harsh environments characterized by great extremes of water temperature and flow. Thus, the gene pool of fish provide for survival in the arid harsh environment. Warner redband are one of only eight separate desert basin populations of interior native redband trout (Behnke (1992). The Warner Basin is between Catlow Basin to the east, and the Chewaucan and Goose Lake Basins to the west. The Warner redband trout are probably most closely related to redband native to the Goose Lake and Chewaucan River Basins (Behnke 1992).

The introduction of the rainbow trout as early as 1925 has altered many of the unique characteristics of the native redband and the brook trout has competed for limited resources with the redband. How extensive the loss of genetic purity has been is not known nor are the locations of the most pure strains of redbands.

The streams in the watershed make up the majority of flow into the Warner Basin and thus are a significant portion of the redband habitat. The other major tributaries to the Warner Basin that support populations of redband trout are Honey and Twentymile Creeks.

Reference habitat conditions for fisheries have been discussed under reference conditions for stream channel and water quality (Reference Conditions-9).

Generally, overhanging sedges, willows and banks provided shade and cover for salmonids in the open meadow systems. In the upper reaches with Rosgen type A and B channels, higher percentages of shade and cover were provided by deciduous trees, conifers, willow and other shade tolerant shrub species. Reference riparian vegetation condition is further discussed under Reference Conditions-8.

Historic use of intermittent streams by fish is unknown.

Water withdrawal since the turn of the century has affected the ability of fish to thrive in the streams. Irrigation water withdrawn from Deep, Camas and Parsnip Creeks reduces summer time flows and raises water temperatures.

Human Uses

A. Prehistory

Archaeological evidence of human occupation shows that humans began to move into the area to extract resources about 10,000 years ago. The area of primary focus was Big Valley (private land). Big Valley is a large, protected, well watered valley downstream from the headwaters of the main stem of Deep Creek. As Deep Creek leaves National Forest System lands, it enters Big Valley and then moves on through BLM-administered lands and enters Warner Valley near Adel. Numerous archaeological sites are found in Big Valley.

Archaeological sites found at higher elevations are usually small, seasonal, multi-purpose hunting and gathering sites. To the early inhabitants, the area near Adel was probably a 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 Warner Valley and later in the harvest season, Big Valley. The food resources were similar in both areas. The same plants matured much later in the season in Big Valley as compared to Warner Valley, which gave the local inhabitants a sustainable source of food with abundant periods of production.

The many small upland lithic scatter sites were probably related at times to the few much larger complex habitation sites located in Big and Warner valleys. This scheme of seasonal migration probably continued for 8,000 to 10,000 years or more until the Euroamerican people started to move into the area about 150 years ago. This seasonal gathering of the aboriginal peoples had little to no impact on the landscape. Digging roots in the meadows only increased the meadows 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.

There are significant large numbers of archaeological sites known to exist. Research is currently being conducted on many of these sites.

B. History

The Deep Creek 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 the high elevation areas. By the turn of the century, there were a half dozen places in and around the watershed.

The first visible impacts to the landscape were the overgrazing of sheep and cattle and the beginnings of logging. Lumber markets grew from local to widespread at the end of the reference period.

There are now 20 grazing allotments, but none of these allotments existed 100 years ago. Prior to Euroamerican 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 was still large areas of public land which served as open range. Many of these areas were grazed on a first come basis and overgrazing was common. Fifty years ago, there were homesteads both active and abandoned scattered throughout the watershed. Following the Taylor Grazing Act in 1934, grazing districts were formed and allotments established. The BLM allotments as we know them now were just beginning to be formed with fence and allotment boundaries being established. From these early allotments current day boundaries have evolved.

Even though the number of grazing livestock peaked in the early decades of this century, not until the end of the reference period was considerable effort made to manage livestock numbers. 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 Deep Creek watershed. Cattle and horse head numbers were also 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, like the 1930s, livestock were basically left on the forest year-round. More typically, season long grazing extended up to eight months. Most improvements from reductions of livestock numbers and length of the grazing season were seen at the lower elevations along the stream courses.

Impacts from this agricultural activity can still be seen today, especially in the condition of some of the stream banks and riparian areas at the lower elevations. Also, plant species composition of the landscape has been altered to some extent by intensive grazing. Grazing, however, does not seem to have had an impact upon the presence of food plants of interest to the American Indian people.

No historic sites of interest are known to exist within the BLM portion of the watershed other than the route of the Oregon Central Military Road. Camp Warner, while important, is located on private property. Portions of the Oregon Central Military Road have been identified with markers placed by the local historical society.

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 synthesized and interpreted. The interaction of biological, physical and social processes taking place in the watershed are explained. The capability of the system to achieve key management objectives is evaluated.

Erosion Processes

Soil is considered a nonrenewable resource because soil formation requires very long periods of time. Soil is also considered a basic resource because the abundance and distribution of most other resources depends on soil characteristics. Soil erosion normally removes more of the surface than subsoil layers. Consequently, proportional nutrient losses are greater at the surface and effects on site productivity are proportionally larger as well. Accelerated erosion from management actions usually exceeds soil formation rates, whereas natural erosion is in balance with soil formation rates.

Under ideal circumstances soil formation is in balance with or occurs at a faster rate than soil erosion. The natural rates of soil formation are generally considered to be between 0.1 ton/ac/yr and 2.0 ton/ac/yr (Schumm and Harvey 1982). Soil development rates are believed to be closer to the lower range because of weather and climatic conditions characteristic of the area.

The two key factors involved in minimizing surface erosion, regardless of climatic conditions or topography, relate to live and dead organic matter and soil physical properties. The importance of a vegetative-organic matter cannot be over emphasized.

The cause of accelerated erosion is directly related to the degree of soil disturbance from all management activities occurring over time. The primary activities are road building, logging, grazing and burning. These are activities that remove the surface organic layer that provides protection to the mineral soil layer below and change the inherent physical soil properties that restrict water movement within the soil mantel. This restriction results in more water flowing over the surface which also contributes to increased erosion.

A. Roads

Analysis of erosional processes shows that roads are producing the highest rates of soil loss on a per acre basis. Soil loss means that material is moved from one location to another but it does not necessarily mean that all of the material will enter the stream channel. Roads alter the natural drainage patterns and concentrate surface and subsurface flows into ditches where erosion results. Road surfaces are usually compacted as well, which restricts infiltration of surface flows and further acts to concentrate flows moving down the road surface and/or ditch.

The amount of soil erosion related to this road network ranges from about 1.8 tons/acre/year to 3.7 tons/acre/year, depending on the erosion rate of the soil in each subshed. The subsheds are ranked in order of erosion potential below in Table 43.

Table 43. Soil Erosion Rates by Subshed

Subshed	Geologic Erosion Factor	Road Erosion Rate tons/acre/year	Timber Sale Erosion tons/acre/year
Big Valley	.86	3.7	.12
Lower Camas	.83	3.6	.12
Mud Creek	.68	2.9	.10
Cressler Creek	.68	2.9	.10
Upper Deep Creek	.65	2.8	.09
Burnt Creek	.59	2.5	.08
Crane Lake	.59		
Blue Creek	.57	2.4	.08
Lower Deep Creek	.56	2.4	.08
Willow Creek	.55	2.4	.08
Drake Creek	.54	2.3	.08
Peddlers	.5	2.1	.07
Gibson Canyon	.48	2.1	.07
Dismal	.46	2.0	.06
Horse	.44	1.9	.06
Upper Twelvemile	.42	1.8	.06
Fifteenmile Creek	.42	1.8	.06

Erosion rates relating to roads are consistently much higher in areas with rhyolite parent material and in alluvial deposit areas.

Culverts and water bars that are not properly spaced, maintained or constructed further aggravate the erosional process. Roads act as water collection devices, therefore proper spacing of culverts and water bars is essential to avoid concentrating flows to the extent that flowing water erodes either the ditch or soils below the diversion point.

Another major factor contributing to erosion relating to the road network is the condition of the soil material available for plant growth. Any road that is constructed by excavating into the hillside will result in subsoil and/or bedrock being the primary growth medium for reestablishment of vegetation. These subsoil materials are lower in fertility and organic matter, higher in clay, stonier and drier than the surface soil. Cut and fill slopes are often steep and will dry ravel for many years.

Mass movement is not a major concern within most of the subsheds. However, Upper Deep Creek subshed has areas of historic landslides (Current Conditions-4) which are susceptible to further mass failure. Projects within this area should be evaluated for the risk of mass failure with new roads and clearcuts being avoided where possible.

The potential also exists for debris avalanches on the steeper slopes on rhyolitic eruptive centers. The major areas of concern are within the headwater areas of Blue Spring, Peddlers, Drake, Mud, Upper Deep and Dismal Creeks. Road building and logging on these cohesionless soil types are the major activities increasing debris avalanche risk.

B. Logging

Timber harvest, utilizing conventional logging equipment, requires an extensive road network. Primary skid trails, secondary skid trails, temporary roads and landings are necessary with conventional equipment. Dispersed harvesting techniques utilized most frequently within the watershed resulted in additional soil disturbance (i.e. compaction, displacement and puddling).

The transportation system network results in surface soil disturbances similar to those described above for system roads. Skid trails, temporary roads and landings change the natural flow regime of the landscape and tend to concentrate flows just as system roads do. Any activity that acts to concentrate flows increases the risk for overland flow and erosion (Table 43).

Forested soils have a naturally low bulk density which ranges from about 0.7 to 1.2 grams/cm3 for surface soil layers. This means that forested soils consist of only about 30 to 50% mineral and organic matter and the remainder is air space partially filled with water. They are porous with high water infiltration rates. Because of this porosity, the forested soils are sensitive to compaction, especially the basalt soils. The rhyolite soils have lower risks to compaction.

One timber sale harvest unit (Willow Hawk) was intensively monitored to determine overall adverse impacts. This unit was sampled with random transects to evaluate cumulative effects from past impacts. The total adverse impacts were 40% in this area primarily from compaction exceeding Forest plan standards and guidelines.

Many areas have been logged several times over the last 50 years. Forest-wide monitoring data shows cumulative results that are typical across the forest with soil compacted in a range of 20 to 40% in tractor logged areas. Soil compaction may last for at least 40 to 60 years which means that adverse effects are cumulative over the years.

The cumulative effects of exposed mineral soil, compaction and displacement result in an estimated accelerated erosion rate from about 50 tons per year within the Cressler Creek subshed up to 600 tons per year in the Mud Creek subshed. This is due to the degree of past impacts and also the basic erosion rate as related to soil/bedrock characteristics. These estimates are erosion rates only and identify estimated rates of soil movement. It does not mean that this amount of soil is entering the stream systems as sediment.

C. Grazing

Almost all soil damage related to grazing is associated with riparian areas such as springs, seeps and wet and moist meadows. No damage of any significant extent is known to occur on well drained upland soils. Riparian soils have restricted internal drainage and the water table remains at or near the surface much later into the summer months as compared to upland soils. Wet and moist soils are very susceptible to damage because soil strength decreases rapidly as the amount of moisture in the soil increases. Soil strength is at a minimum when saturated.

During the early settlement period, grazing levels were intensive on the forest. Records indicate that season long grazing was the rule and extended for up to 8 months. For example, in 1910 cattle numbers were 26,000 and sheep numbers were 110,000 (1957 Range table available at Supervisor's Office). This is about 450,000 permitted AUMs for the forest. It is assumed that proportional use occurred within the Deep Creek watershed. Current permitted use on the Fremont National Forest is 71,000 AUMs from cattle which is about an 84% reduction from the 1910 level.

The intensive grazing resulted in gully erosion in meadows. Bradley (1915) states in part, "There are many instances of erosion due to grazing and in every case, as far as is known, cattle and horses were responsible. All over this Forest there are sage brush flats with channels of varying depths and steep banks which are continually sliding, being washed away every time there is abnormal flow. There is little doubt that these flats were originally small meadows, well irrigated by the water which used to spread all over them, there being no definite creekbed. Some of these flats are still meadow, with the grass dying out from lack of water and the sage brush coming in. In others there has been no erosion and the water spreads out as it always did, thereby supplying succulent forage and conserving the moisture, keeping up a gradual flow until later in the season".

Later Bradley states, "There are a great many areas on this Forest where erosion is occurring, due to over grazing which occurred before the National Forest was established, and some where the erosion has been arrested, or partially so". He documents a specific example on Dog Mountain Creek located outside of the watershed on the southern portion of the forest "Before this area was grazed the whole of the flat, approximately 200 acres, was a fine mountain 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. The causes of erosion on areas like the above and the conditions which led up to it are plain, especially to those who have had the opportunity of watching the gradual change over a long period".

It is evident from documents such as that quoted above and other historical accounts that the current condition of riparian areas was initiated in the late 1800s to 1930s. The intense grazing which occurred during that time resulted in excessive removal of the protective vegetation. Gully erosion soon followed as the meadow had lost its protective mat and spring flows cut down into the mineral soil.

The current condition of most of the degraded meadows is less the result of floods than the damage that had already occurred as evidenced by the concern of Deputy Forest Supervisor Bradley in 1915. Also, most of the channel downcutting is not related to road building and logging as very few roads and only limited logging had occurred by that period of time.

D. Burning

Wildfires expose the surface mineral soil to erosion and result in hydrophobicity (water repellency) of the soil surface which reduces infiltration of water and increases erosion risk.

Severe fires did occur historically and continue to occur today. On the Fremont National Forest, aggressive fire prevention and suppression have resulted in increased quantities of fuel per acre and an invading white fir understory that provides increased ladder fuels. These factors have created a high risk of wildfire in many places on the forest. However, experience shows that the risk of catastrophic fires does not appear to be as great in this watershed.

Hydrology

A. Base Flows

1. General Discussion

Low flows during August through November are assumed to be base flows for the watershed. It is assumed that base flows are slightly lower today than during the reference period. Management activities including road building, logging, livestock grazing and the decline in beaver populations have contributed to lower base flows. These factors are discussed below.

2. Base Flow Responses to Road Building

Base flows are intercepted by roads that are cut through hillsides and intercept the subsurface flow. Most road cuts are shallow and this is not considered to be a large contributor to decreased base flows.

3. Base Flow Responses to Logging

Timber harvest can decrease evapotranspiration and potentially make more water available for base flow. Timber harvest has occurred over about 9,000 acres. However, planting of clearcuts and gradual replacement of ponderosa pine with white fir and pine undergrowth has occurred. Tables 12 and 38 show there has been a shift towards more canopy in forested stands today than existed in reference conditions. All subsheds, except Cressler and Dismal Creeks, have experienced a shift towards more canopy in the 26-55% range. ISAT shows that new openings are less than 12% of any subshed. This is verified by district information (Post 1998). Historically, about 8% of the forested watershed would have been in openings from fire/insect/disease (Petersen 1998). This indicates that there is slightly more openings today than in reference conditions.

Any additional base flow that may have been derived from clearcuts is likely negated by increased canopy in timbered stands and encroachment of conifers and junipers into meadows and stringer areas. This is further verified by Baker (1988) who found that in arid situations, where water is limited, potential savings in water by partial cutting is often used by residual trees.

The effects to base flow of increased numbers of white fir and juniper are unknown. These trees continue to draw water from the soil during dry periods when ponderosa pine shut stomata and discontinue use of water. The increased number of white fir and juniper may result in some loss of water that would be available for stream flow. However, increased basal area within forested stands most likely have not decreased base flow to a large degree. Personal communication with Troendle (1998) shows that once trees have fully occupied a site, increased leaf area does not usually result in increased water use. Thus, base flow would not decrease from the increased understory. There is a data gap regarding site occupancy in historic conditions. For this analysis, it is assumed that the site was fully occupied in reference conditions and that excess water was not available for base flow.

4. Base Flow Responses to Grazing

Livestock grazing can affect the riparian environment by changing, reducing or eliminating vegetation and through channel widening, aggrading or degrading (lowering of the water table)

(Platts 1991). A study of almost 250 miles of National Forest System riparian areas in the Intermountain Region showed that grazing conflicts with riparian-dependent resources were most common in Rosgen B type stream channels with fine-textured soils and with most C type channels (Clary and Webster 1989). These are the soil and stream types described in the reference conditions for meadow areas.

Historic livestock grazing has led to downcut stream channels which created lower base flows. This is most evident in low gradient alluvial deposition areas. Many low gradient streams are on private property. Livestock grazing history on private property is unknown. Intensive livestock use on these lands is assumed to be a major contributor to riparian degradation. Lowering of the water table may have resulted in less water storage in alluvial depositional areas resulting in lower base flows.

5. Base Flow Response to Change in Beaver Community

In historic times, beaver populations in North America were estimated to be at least 60 million individuals over 15.5 million square kilometers. This equates to 4 beaver per km2 (Lowry 1993). Beaver density today is far below this number. Beaver dams act as storage sites for sediment and provide structure to the stream. This helps to create a favorable environment for developing riparian vegetation. Beaver dams also increase the lateral extent of bank saturation for increased groundwater storage. Greater storage in the stream bank enhances flow during summer months and causes improved distribution of stream flow throughout the year (Olson and Hubert 1994).

The decline in beaver populations has contributed to decreased base flow. This effect is most pronounced in alluvial depositional areas. The change in base flows from this cause is unknown.

6. Channelization

Base flows are lowered by channelization as discussed in Current Conditions-5.

7. Effects of Reduced Base Flow on Other Resources

The magnitude of change in base flows is unknown. However, factors identified above point toward reduced base flow in current conditions, mostly from lowered water table in alluvial depositional areas. To a lesser degree, base flows may have decreased as a result of interception of base flows by roads, conifer/juniper encroachment into meadow areas and increased evapotranspiration.

Reduced base flows and loss of water table affect other resources including fish populations, riparian vegetation, wildlife, recreation and agricultural crops that depend on irrigation. Fish populations are affected by lower water volumes. Lack of flow affects pool habitat by decreasing pool size and increasing water temperatures and shallow flows may create barriers to fish movement. Decreased base flow can decrease water for maintenance of riparian communities and negatively affect riparian associated wildlife resources.

Agricultural irrigation (March 1 - October 1) may be negatively affected by decreased flow during summer months because less water is available. Irrigation in Big Valley has altered base flows to an unknown extent below that location.

B. Mean Flows

1. General Discussion

Mean flows at the Deep Creek gauging station were compared using years with precipitation in the range of 9.9 to 18.3 inches measured at Lakeview. No significant shift in monthly mean flows were noted.

Troendle (1982) notes that generally 20 to 30% of a watershed has to be harvested before a significant change in flow can be detected. As shown in Tables 12 and 38, canopy has increased in forested areas and clearcuts occupy less than 12% of the watershed. Equivalent Clear Cut openings were estimated to be 8% of the watershed in reference conditions. The small increase in openings from timber harvest has not significantly changed mean flows.

C. Peak Flow

1. General Discussion

Increased peak flows are occurring in current conditions. Analysis of data from the Deep Creek gauging station shows increased duration of flows exceeding bankfull (Figure 1). A study by Troendle (1991) shows that timber harvest can alter peak discharge and change the duration of flows particularly in the range of 80 to 120% of bankfull flow. Flows in this range doubled as a result of timber harvest in the Fool Creek Drainage of the Fraser Experimental Forest in Colorado. Flows above 120% bankfull were less affected. The study was performed on a 290 ha area with 40% of the watershed harvested through alternating clearcut and leave strips. Similar results were obtained in the analysis of Deep Creek. It is assumed that the effects of timber harvest, mainly roads and to a lesser extent detrimental soil compaction, have created conditions that contribute to this change.

Natural climatic changes are beyond the scope of this analysis. However, a review of weather records for the Thomas Creek watershed showed that there had been a warming of ambient air temperatures in the Town of Lakeview from December through April. Climatic shifts and frequency of storms is unknown, but these may be contributing to increases in peak flows. Vegetation changes are not considered to contribute any significant amount to increased peak flows. Causes of change in peak flow are discussed below.

2. Peak Flow Responses to Vegetative Changes

Tables 12 and 38 show there has been a change in vegetation structure. The greatest change has occurred in ponderosa pine. More canopy (in forested stands) is present today than existed in historic conditions. This shift is within the natural range of variability.

Commercial timber harvest has removed merchantable trees through various silvicultural prescriptions. However, as a result of white fir encroachment in the understory, the overall canopy has increased instead of decreased, except in some clearcuts that are not fully stocked (less than 12% of any subshed). The result is more canopy in forested stands today with a few scattered clearcut openings. Peak flows have not increased significantly as a result of canopy removal.

Additionally, increased ground cover has reduced the possibility of above ground flow that can occur in response to intense rain storms. Flash flows from thunderstorm events are not estimated to be a factor.

3. Peak Flow Responses to Road Building

Roads affect peak flows by creating conditions of increased drainage efficiency. A USGS study showed that drainage density is directly related to flood runoff as measured by the mean annual flood, Q2.33=1.3 D2 (Carlston 1963). Table 9 shows drainage density is increased significantly by the addition of roads. Because roads can increase the mean annual runoff by a factor of square (Carlston 1963), they can be a significant contributor to instantaneous peak flows. This increase in drainage efficiency is considered to be the largest factor affecting increased peak flows.

4. Peak Flow Responses to Compacted Soil

Soil compaction is contributing to increases in peak flow. Compacted soils from logging operations have been measured across the forest in the range of approximately 35 to 45%. Similar compaction levels are assumed to have occurred in the watershed on tractor logged ground.

Research shows that when 12% of the watershed is in a compacted condition, peak flows can increase by 50%. The percentage of compacted soil appears to be a good indicator of the increased size of peak flows (Harr et al. 1979). However, not all areas of compacted soil contribute toward increased runoff to the same degree.

5. Summary of Peak Flows

Increased drainage efficiency from roads and compacted soil are estimated to be the primary causes for increased peak flows. Clearcut openings are a small part of the watershed (less than 12%), and are not considered a factor in peak flows. Future projects should seek to minimize increases in peak flow. This can potentially be achieved by planning vegetative treatments that stay within or above the mean of natural range of variability for canopy.

Peak flows are important for providing flood water and sediments to adjacent floodplains. Stream channels with good riparian vegetation and properly functioning stream morphology can withstand high flows and are less vulnerable to degradation.

Vegetation

A. Upland (Forested) Vegetation

Main contributors to the difference between current and reference conditions for forested communities are increased timber harvest and associated road building, alteration of the natural fire regime and repeated insect attack.

1. Timber Management

Timber harvest reduced the acreage dominated by large old trees. Road construction has removed a significant portion of the forested land base from coniferous tree production. Related timber management practices, such as machine piling of logging slash, scarification of skid trails, closure of temporary roads and erosion seeding have prepared a seed bed for nonnative grasses to invade forested sites. A common practice was to seed with nonnative grasses during any ground disturbing activity.

In reference conditions, many of the present low elevation pine associated stands were more open and park like. The east slope of Crane Mountain below 6,500 feet is in the drier rain shadow of this range and had more open pine stands extending up slope to this elevation. The east-west drainage of Camas Creek usually had the open pine stands extending only to about 6,000 feet in the pine associated type because of increased moisture on north slopes.

Ponderosa pine stands during the presettlement and early historic periods were large groups of large old trees with small patches of reproduction where an event, most likely from insect attack, had released growing space for new trees. These stands have become more dense with the advent of modern fire suppression. Many large old pine in these stands were removed during the early logging era and the remaining pine cultured into the future crop. These stands are presently in a pole to small saw log condition and have had fire suppressed as in the pine associated stands.

Pine associated stands were becoming dense with shade tolerant white fir as fire suppression became more effective. By the 1950s, much of the white fir understory was developing into a pole sized component. The advent of logging further changed species composition of large stands. Logging practices of the 1950s through the 1980s removed large valuable ponderosa pine in a selective harvest covering large blocks of many hundred acres. Only the biggest and best pines were removed on a regular basis. This led to a dysgenic selection against the best of the ponderosa pine gene pool while leaving large blocks of young white fir. A common practice was to remove the large pine and culture the white fir second growth. The white fir component was to be grown quickly to an average stand diameter of fourteen inches, cut and replanted to ponderosa pine seedlings. The process had many years of implementation before many of the thinned and cultured stands suffered mortality with the drought in the 1980s and early 1990s. The lower moisture regime stressed stands and made them more susceptible to fir engraver as a secondary mortality agent. The increased amount of foliage on true fir also shortened the time between epidemic attacks of Modoc budworm.

2. Fire

The inherent fire disturbance regime for pine and lower elevation pine associated in reference conditions was a return interval range of 25 to 75 years. Modern fire suppression methodology and objectives have changed this regime to one of more infrequent higher intensity fires. More fire disturbances now are a stand-replacing event where reference condition fires were low intensity maintenance fires in the lower elevation pine stands and more infrequent, small and scattered events in the higher elevation mixed conifer forest. Fire frequency probably declined with increasing elevation.

Average stand diameter between reference and current forest conditions has been lowered drastically. Removal of large diameter trees and the change in disturbance regimes has allowed forested stands of most species to become denser with small diameter trees. Prior to management activities and fire suppression, native grasses and shrubs were dominant in the nontree layer. The change in fire patterns and management activities has allowed a shift toward shrubs such as sage and nonnative grasses until the forest canopy closes enough to shade out shrub and grass development.

Historically, frequent fires (25 to 75 year return interval) in ponderosa pine prevented large scale establishment of young trees over large areas. Pockets of regeneration would occur where large trees died or were flamed-out or where fire would consume small areas of heavy fuel and burn intensely. In current conditions, the lack of stand cleansing fires may have allowed the survival of more small trees, both ponderosa pine and juniper. Many acres of ponderosa pine have a higher understory density along with the remaining large overstory and are becoming more susceptible to western and mountain pine beetle. Shrubs that remain today are beyond the normal range of maturity and replacement cycle associated with frequent fire. It is a decadent condition.

Juniper woodland expansion is still relatively constant in the absence of a natural fire regime, but the rate of its establishment is somewhat slower than the period prior to 1945. The time sequence of wet climatic conditions, overgrazing by livestock and the advent of fire suppression in the early 1900s created the conditions favorable to a considerable increase in the distribution and density of juniper along the forest/desert ecotone. These new juniper woodlands pose a serious threat to watershed and ecosystem health on many sites. Juniper competition leads to fewer understory plants, less soil cover, lower water infiltration rates, more opportunity for overland flow and soil erosion, greater nutrient loss, and a less productive site both from the standpoint of plant species and animal species richness and abundance.

Higher elevation white fir and lodgepole pine probably have not been as radically altered by the advent of fire suppression as have low elevation pine and pine associated. Historically, these stands had a longer fire return interval of 60-300+ years. When an event did occur, it was a small to large scale stand-replacing event that covered several hundred if not thousands of acres. The fire intensity was high enough because of the large fuel loading to consume most of the biomass under dry conditions. The larger patch size of evenaged forest created from these scattered events was different from the current condition. Patch size and structure would vary across the landscape at any one time with large evenaged and unevenaged stands. The shrub-grass-nontree layer would also fluctuate across the landscape depending on overstory cover, stand density, moisture and available light.

3. Insects and Disease

Insects, most specifically fir engraver and Modoc budworm, have impacted vegetation in the forested environment as a result of the changed vegetation density and composition between reference and current conditions. On the 1947 timber type map, there was much less white fir noted within the pine associated forest type. By this time, wildfire would have been suppressed for almost forty years and a marked increase in white fir understory should have been apparent. However, the lack of reference to white fir on the 1947 map may have been due to data collection and/or the lack of interest or understanding of white fir, its ecology and successional development. Stems present at that time were probably still small saplings and relatively nonsusceptible to insect attack. In reference conditions, both insects were present in the area, but maintained at an endemic level due to food supply. Increased white fir size and density, and drought caused insect populations to increase rapidly in the 1980s and 1990s. The natural population suppressors of food supply and the virus control of Modoc budworm had less of a control effect.

Historically, western and mountain pine beetle were active in forested stands killing large diameter ponderosa pine when its vigor was reduced by old age, drought, poor soil or a variety of conditions that increase stress on large old trees. During drought cycles, the western pine beetle would take out large blocks of large old trees. Much of this large tree component has been removed by harvest in the current period. Western pine beetle continues to be a major threat to the remaining large old trees because of increased stress from the dense understory for moisture and nutrients. Ponderosa pine and pine associated will continue to be at risk of mortality where the density remains above the upper management zone for Stand Density Index (SDI).

Lodgepole pine is currently at risk in the Dismal and Deep Creek drainages where the density of nine inch dbh trees exceeds thirty per acre. These stands are vulnerable to attack from mountain pine beetle and will likely undergo major change in the next decade or two. Insect attack appears to be a major player in the development and replacement of these stands.

Historically, dwarf mistletoe was scattered throughout the landscape and had little impact on ponderosa pine or true fir. While always present, localized pockets of infection developed and when a fire swept through the infected pockets a small group of trees usually flamed-out as fire caught the mistletoe brooms. The pockets were sanitized and new seedlings were established from surrounding seed sources. The increased density of understory trees has increased the level of infection over reference conditions. There are localized areas of infection in Willow and Burnt creeks that are continuing because of fire control. Eglitis et al. (1993) identified the potential for spread of mistletoe infection to be the greatest in single species stands with multi-storied canopies. Current conditions and management emphasis to develop and maintain structure or multi-layered canopies, especially in ponderosa pine, is ideal for the maximum spread of mistletoe.

Root diseases, especially Annosus root disease (Hetrobasidium annosium), is prevalent in true fir and pine associated. It is at a higher potential for spread and effect than in reference conditions. The increased stress caused by density of all species has been compounded by harvest activity. Eglitis et al. (1993) indicated that white fir or stands with a major component of white fir that have been entered twice or more for harvest are at very high risk of the spread of Annosus root disease to 100% of the stems. Increased stand density over reference conditions has also resulted in an increased potential for the occurrence of Armillaria. Root disease has a major impact on the reduction of wood production for commercial use by reducing the growth and increasing mortality of the managed species.

B. Rangeland

Livestock grazing is argued by many researchers as having the most widespread influence on native ecosystems of western North America (Fleischner 1994, Belsky and Blumenthal 1995, Madany and West 1983, Harris 1991 as referenced in USDI, BLM 1996). Numbers of studies report effects associated with livestock grazing in western North America including disruption of ecological succession by producing and maintaining early seral vegetation; loss of microbiotic soil crusts which play an essential role in nutrient cycling and nitrogen fixation in arid ecosystems; deterioration of soil stability and porosity with concomitant increases in soil erosion and compaction; alteration and degradation of riparian habitat; destabilization of plant communities by aiding the spread and establishment of exotic species such as cheatgrass (Bromus tectorum); reduction of biological diversity; and major alterations and conversions of community organization such as transforming native grasslands to juniper woodlands.

Livestock have altered the species composition of plant communities, ecosystem structure and ecosystem functioning. Species composition of plant communities are affected in essentially two ways: (1) active selection by herbivores for or against a specific plant taxon, and (2) differential vulnerability of plant taxa to grazing (Fleischner 1994 as referenced in USDI, BLM 1996). Because livestock prefer native grasses to exotics, native grasses have been replaced by exotic graminoids and weedy species which are more successful in colonizing areas that have been grazed or disturbed.

Livestock grazing has been and still is the most significant impact on low sagebrush communities. Wildfires are rare with the fire return interval estimated to be 150 years (Miller 1998).

The condition and trend of sagebrush and juniper/sagebrush communities are of primary importance because sagebrush is either the dominant or codominant rangeland type in the watershed.

The unregulated and excessive grazing in the first half of this century probably reduced the amount of Idaho fescue and bluebunch wheatgrass present on low sage sites easily accessible and close to water. Currently, these sites are rated in mid-seral condition and it is often the abundance of bottlebrush squirreltail that results in the mid-seral rating. Bottlebrush squirreltail is a prolific seeder that increases under favorable climatic conditions. Therefore, when excessive grazing reduced Idaho fescue, especially during drought years, bottlebrush squirreltail was ideally suited to take advantage of the opening in the plant community and increased on these sites. Under current management with rest rotation and deferred rotation grazing and utilization levels less than 50%, Idaho fescue and bluebunch wheatgrass appear to be at least stable and may be increasing in some areas.

Juniper-low sagebrush grass sites with large old growth (125+ years old) juniper escaped wildfires in the past because these sites are on shallow soils with relatively low plant productivity. About 22% is in late seral condition. These large old junipers with a good grass understory create a unique habitat and any prescribed fires in these areas should be done to maintain this habitat.

Only 4% of the juniper-big sagebrush-grass acres is in a late seral condition compared to 27% for big-sagebrush-grass. This smaller proportion of late seral vegetation means juniper dominated sites have lower production of desirable perennial grasses such as Idaho fescue and bluebunch wheatgrass. The lower production usually corresponds with less ground cover and ultimately more soil erosion. This is especially a concern in Gibson Canyon, Drake and Peddlers Creek subsheds where the juniper-big sagebrush-grass is now more abundant than big sagebrush-grass. Most of the junipers in these sites have established in the last 100 years and are at least partially the result of man's activities. The initial disturbance from excessive grazing in the early part of the century combined with aggressive fire fighting has allowed junipers to establish and flourish in big sagebrush-grass. Once established, junipers with their extensive root systems compete well with sagebrush and herbaceous vegetation. The presence of young junipers illustrates that juniper continues to invade sagebrush-grass but probably not at the pace it did in the first half of this century. The use of prescribed fire combined with good grazing management should reduce the amount of juniper. This should improve ecological condition by increasing the production and diversity of herbaceous vegetation.

Antelope bitterbrush and mountain mahogany appear to be at least stable under current management. Any prescribed fires and post fire management should be done to enhance these types and not damage them.

Aspen patches are small and not even mapped as a separate vegetation type. However, they are unique and therefore valuable as wildlife habitat. Junipers are invading many of these patches in the absence of fires, and the short lived aspens (125 years) will eventually die out and be replaced by junipers.

Structural changes in forests have also resulted from livestock grazing. Livestock have reduced the amount and vigor of the native grass and herbaceous cover on the forest floor, resulting in both an increase in tree seedling density and a reduction in fine fuels that carry frequent, low-intensity ground fires (Miller 1988, Karl and Doescher 1993 as referenced in USDI, BLM 1996). The increase in tree seedling density and disruption of the natural fire regime have led to the increase in dense understories of shade tolerant conifer species such as white fir and the reduction of shade intolerant conifer species such as ponderosa pine. Forest structural changes have in turn led to increases in water and nutrient stress among trees, disease and insect problems, and ladder fuels and woody fuel loads on the forest floor that increase the risk of high intensity, stand-replacement fires.

C. Noxious Weeds

The numbers and species of noxious weeds continue to grow each year. Weed seeds are transported along roads by vehicles of all types and by livestock coming from weed infested areas. Disturbed sites, such as logged areas, road construction and areas of livestock concentration are areas susceptible to weed infestation. Weed infested hay brought in to feed horses at recreational sites and hunter camps is also a source of weeds. Many of these species are still in isolated populations and can be exterminated or contained if found and treated. The BLM portion of the watershed has been inventoried for noxious weeds and currently these sites are being treated and monitored. The current weed treatment contract also includes National Forest System lands. The current strategy is to use an integrated weed management plan that includes inventory, monitoring and treatment using chemicals, biological agents, prescribed burns and mechanical means.

A formal weed advisory group is being formed to coordinate weed treatment between all landowners in the Warner Valley. This group includes several landowners in the watershed.

D. Riparian Vegetation

Few examples of pristine riparian areas remain due mainly to past grazing practices. More than 75 years of intense grazing from domestic livestock have modified the riparian species composition. Cattle browse and trample shrubs and tree seedlings and reduce soil productivity through compaction and nutrient export. They can also contribute to bank sloughing and erosion. These can lead to channel downcutting and lowering of the water table. Lower water tables in riparian zones have changed the vegetative character and impaired floodplain functions. Willows and cottonwood diminish as the water table lowers. Soil that is no longer held in place by the vegetative system is subject to rapid erosion. The eroded material quickly contributes to the sediment load in the stream.

There is wide variation in the type and condition of riparian areas within the BLM portion of the watershed. Riparian areas have been some of the most impacted areas during the last 100 years. About 17% of riparian vegetation is in early seral condition and this is all within the Nevada bluegrass type. About 48% is in unknown condition because of the large amount of private land. Approximately 70% of riparian vegetation is on private land and only 30% on public land.

Much of the damage to riparian woody vegetation, such as the loss of cottonwood and willow, was done in the first half of this century when there was little or no livestock management of public lands. Current grazing management is slowly correcting much of the damage done to riparian areas on public lands. About 66% of public land stream reaches are excluded from grazing and 25% are only being grazed early in the spring every other year. In these areas, there is evidence that willows are returning and sedge and rush are becoming more established on sand bars and bare areas. Some of the private land is being managed in conjunction with public land, such as along Deep Creek in the Sagehen allotment. However, for most private land, riparian condition, trend and management is unknown.

Fire suppression has affected the vegetative component of the riparian zones by allowing encroachment of shade tolerant conifers into aspen and cottonwood. 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.

E. Sensitive Plant Species

These plant populations will continue to be monitored and managed in accordance with the Endangered Species Act of 1973 and subsequent rules and regulations. In addition, the watershed will be managed in accordance with BLM and Forest Service policies and conservation strategies for sensitive plants and their habitats to prevent them being listed under the Endangered Species Act.

Livestock grazing has occurred in the Dismal Swamp area for the past century with apparently little effect on this habitat type. Current grazing standards will ensure continued existence of this unique habitat type. There is currently low-standard road access for pickups or passenger vehicles.

F. Cultural Plants

These plants and their habitats will be managed in consultation with Native Americans.

Stream Channel

A. Canopy Impacts

The Forest plan includes limits of impacts that may occur in commercial forested portions of the watershed. For the Deep Creek watershed, there is a threshold of 30% that can be impacted at any one time (35% for the Twentymile subshed), unless more stringent requirements are necessary for other resources. Presently, less than 12% of any subshed has canopy in an impacted state (Table 45), thus, the Forest plan standards and guidelines are met.

Canopy impacts are derived from ISAT using Petersen's (1998) work for this analysis and from clearcut information provided by Post (1998).

B. Road Impacts

The effects of roads on hydrologic functions and resultant water quality are well documented in the literature. Roads influence groundwater interception, runoff distribution over time and space, and the potential for sediment production and delivery to streams.

Table 44 places road densities into three risk classes (low, moderate, high) relative to overall watershed relief.

Table 44. Road Density (mi/mi2)

	Watershed Relief	
	>30%	<30%
Low Risk	<2	<3
Moderate Risk	2.1-3.5	3.1-4.5
Highest Risk	>3.6	>4.6

In all cases, watershed relief is less than 30%, therefore, the second column of Table 44 will be used.

Table 45 uses a graph from a process developed by the USDA Forest Service (1993, as amended by Fremont National Forest in 1997) to rate the watershed risk from the combined effects of road and canopy impacts.

Table 45. Watershed Risk Rating

	Canopy Impact (% Subshed)	Road Density (Mi/Mi2)	Watershed Risk Rating Roads and Canopy
Mud Creek (01)	5	5.1	High
Lower Camas Cr. (02)	2	2.9	Moderate
Horse Cr. (03)	4	2.5	Low/Moderate
Burnt Creek (04)	6	4.4	High
Crane Lake (05)	4	2.3	Low
Upper Deep Creek (06)	3	1.7	Low
Dismal Creek (07)	1	2.4	Low
Willow Creek (08)	8	5.1	High
Cressler Creek (09)	1	2.7	Low
Big Valley (10)	~	0.5	~
Lower Deep Creek (11)	4	1.1	Low
Blue Creek (12)	4	1.6	Low
Peddlers Creek (13)	0	1.7	Low
Drake Creek (14)	0	1.3	Low
Upper Twelvemile(101)	~	0.4	Low
Fifteenmile (103)	~	2.5	Low
Twentymile (104)	~	~	~

C. Determination of Cumulative Watershed Effects (CWE)

The method chosen to evaluate CWE uses the above watershed risk rating in combination with stream channel conditions. This method follows the USDA Forest Service ESA Section 7 process as amended by the Fremont National Forest (1997) to reflect current State of Oregon standards, percentiles in the ICBEMP and biological thresholds for sediment. The intent is to allow a comparison of variables that could be limiting to fish populations in a given watershed. Recommended key variables include the following:

- Primary pools (pools per mile),

- Large pools per mile,

- Large woody debris (pieces per mile),

- Temperature (degrees F or C),

- Sediment (percent surface fines, embeddedness or substrate fines).

-Stream Bank Stability (% stable banks)

1. Pools and Large Woody Debris

Pools per mile, deep pools and large woody debris are evaluated against percentiles referenced in the ICBEMP. The following ratings are assigned when using percentiles.

Table 46. Percentile Rating

Percentile	Rating
<50	Poor
50-75	Fair
>75	Good

2. Temperature (degrees F or C)

Water temperature controls the rate of biologic processes and is of critical concern for fish populations and a primary indicator of habitat and channel conditions. Oregon Department of Environmental Quality standards for stream temperature are for a 7-day moving average of the daily maximum temperatures.

Based on these standards the following habitat rating is recommended:

Table 47. Water Temperature Rating

Water Temperature	(oC)
Good	<17.8
Poor	>17.8

3. Sediment

Sediment levels in streams which exceed the stream's natural sediment capacity can have significant effects on habitat for salmonids. These effects can be directly linked to individual fish species and life stages. There are a variety of ways to measure sediment levels relative to fisheries concerns. Three of these measurements are: (1) percent surface fines, (2) cobble embeddedness, and (3) direct measurement of fines in the potential spawning substrate. For this analysis, direct measurement of fines in the potential spawning substrate is used.

Table 48. Habitat Condition by Fines in Potential Spawning Substrate

Habitat Condition	Percent Fines in Substrate
Good	<20
Fair	20-30
Poor	>30

4. Bank Stability

Eroding stream banks can be a primary source of fine sediment in streams and can result in habitat degradation including loss of overhanging banks and floodplain functioning. Spawning substrate, shading, water table, pools and riparian vegetation are all negatively affected when bank instability occurs.

Standards and guidelines in the Forest plan identify management-induced instability as occurring when 20% or more of banks are unstable (p. 30). This standard and guideline was used to develop Table 49.

Table 49. Habitat Condition by Bank Stability

Habitat Condition	Percent in Stable Condition
Good	>90
Fair	70-90
Poor	<70

5. Overall Channel Condition Rating Summary

The following is an evaluation of the key variables for channel condition and shows that habitat conditions vary from good to poor depending on the stream and the reach. Table 50 evaluates the key variables using the Section 7 process (Fremont National Forest 1997). The table provides information by reach with an overall rating for each stream.

Table 50. Channel Condition by Stream Reaches

Reach	Temp Rating	Pools/ Mile	LWD/ Mile	Pools/ Mile >2.6 ft	Unstable Banks	PFC	Sediment Rating	Overall Rating
Mud Creek Subshed (01)								
Mud Creek								
1	Poor	Good	Fair	Good	~	PFC	Good	
2	Poor	Poor	Poor	Good	~	~	Poor	
Overall	Poor	Fair	Fair	Good	~	~	Fair	Poor
Blue Creek Subshed (12)								
Camas Creek								
1(BLM)	Poor	Good	Poor	Good	Good	PFC	~	

Reach	Temp Rating	Pools/ Mile	LWD/ Mile	Pools/ Mile >2.6 ft	Unstable Banks	PFC	Sediment Rating	Overall Rating
2(BLM)	Poor	Good	Fair	Good	Poor	FAR^	~	
3(BLM)	Poor	Good	Fair	Good	Good	FAR>	~	
Overall	Poor	Good	Fair	Good	Fair	~	~	Poor
<u>Horse Creek Subshed (03)</u>								
Horse Creek								
1	Poor	Good	Poor	Good	~	~	~	
3	Poor	~	~	~	~	PFC	~	
5	Poor	Fair	Fair	Good	~	~	~	
7	Poor	~	~	~	~	50% FAR^ 50% PFC	~	
Overall	Poor	Fair	Poor	Good	~	~	~	Poor
<u>Burnt Creek Subshed (04)</u>								
Burnt Creek								
2	Poor	Good	Poor	Good	~	~	~	
3	Poor	Fair	Poor	Good	~	~	~	
4	Poor	Good	Poor	Good	~	FAR^	Poor	
6	Poor	Poor	Poor	Good	~	~	~	
8	Poor	Poor	Poor	Fair	~	PFC	~	
9	Poor	Poor	Poor	Good	~	FAR^	Good	
Overall	Poor	Poor	Poor	Good	~	~	Poor	Poor
<u>Upper Deep Creek Subshed (06)</u>								
Deep Creek - South Fork								
1	~	Good	Poor	Good	Good	~	Good	
2	~	Good	Poor	Good	Good	~	~	
3	~	Fair	Poor	Good	Fair	~	~	
Overall	~	Good	Poor	Good	Good	~	Good	Poor
Deep Creek-Middle Fork								
1	Poor	Good	Fair	Good	Good	~	~	
2	~	Poor	Poor	Fair	Good	~	~	
3	~	Good	Fair	Good	Good	~	~	
4	~	Good	Poor	Good	Good	PFC	~	
5	~	Good	Poor	Good	Good	~	~	
6	~	Poor	Poor	Good	Good	~	~	
Overall	Poor	Good	Poor	Good	Good	~	~	Poor
North Fork Deep Creek								
1	~	Good	Poor	Good	~	AR^	~	Poor
Mosquito Creek								
1	~	Good	Fair	~	~	~	Good	
2	~	Good	Fair	~	~	~	~	
3	~	Good	Poor	~	~	~	~	
4	~	Good	Poor	~	~	~	~	

Reach	Temp Rating	Pools/ Mile	LWD/ Mile	Pools/ Mile >2.6 ft	Unstable Banks	PFC	Sediment Rating	Overall Rating
Overall	~	Good	Poor	~	~	~	Good	Poor
Dismal Creek Subshed (07)								
Dismal Creek								
2	Fair	Good	Fair	Good	~	~	Good	
3	Fair	Good	Poor	Good	~	~	Good	
Overall	Fair	Good	Fair	Good	~	~	Good	Fair
Willow Creek Subshed (08)								
Polander Creek								
2	Poor	Good	Poor	Poor	~	~	~	
3	Poor	Poor	Poor	Good	~	~	~	
Overall	Poor	Fair	Poor	Fair	~	~	~	Poor
Willow Creek								
1	Poor	Good	Poor	Poor	~	PFC	~	
2	Poor	Good	Fair	Fair	~	~	Good	
3	Poor	Fair	Poor	Fair	~	AR^	~	
4	Poor	Fair	Poor	Good	~	~	~	
6	Poor	Good	Good	Good	~	~	Good	
7	Poor	Good	Fair	Poor	~	PFC	~	
8	Poor	Good	Good	Good	~	~	~	
9	Poor	Good	Fair	Good	~	~	~	
Overall	Poor	Good	Fair	Fair	~	~	Good	Poor
Lower Deep Creek Subshed (11)								
Lower Deep Creek								
5(BLM)	Poor	Good	~	Good	Poor	PFC N(0.35MI)	Fair	
6(BLM)	Poor	Good	~	Good	Poor	FAR^	Good	
Overall	Poor	Good	~	Good	Poor	~	Fair	Poor
Peddlers Creek Subshed (13)								
Parsnip Creek								
1(BLM)	Poor	Good	~	Good	Poor	FAR^	~	
2(BLM)	Poor	Poor	~	Good	Poor	PFC	~	
3(BLM)	Poor	Good	~	Good	Good	PFC	~	
4(BLM)	Poor	Good	~	Good	Fair	PFC	~	
5(BLM)	Poor	Good	~	Good	Good	PFC	~	
Overall	Poor	Good	~	Good	Fair	~	~	Poor
Drake Creek Subshed (14)								
Drake Creek								
1(BLM)	Poor	Good	Fair	Good	Good	PFC	~	
2(BLM)	Poor	Good	Poor	Good	Good	PFC	~	
3(BLM)	Poor	Good	Poor	Good	Good	PFC	~	
4(BLM)	Poor	Good	Fair	Good	Fair	PFC	~	

Reach	Temp Rating	Pools/ Mile	LWD/ Mile	Pools/ Mile >2.6 ft	Unstable Banks	PFC	Sediment Rating	Overall Rating
5(BLM)	Poor	Good	Good	Good	Good	PFC	~	
6(BLM)	Poor	Good	Good	Good	Fair	FAR^	~	
Overall	Poor	Good	Fair	Good	Good	~	~	Poor
Roaring Spring Fork								
1(BLM)	~	Fair	Good	Good	Good	PFC	~	
Overall	~	Fair	Fair	Good	Good	NA	~	Fair
<u>Gibson Canyon Subshed (15)</u>								
Lower Deep Creek								
1(BLM)	Poor	Good	~	Good	Poor	PFC	~	
2(BLM)	Poor	Good	~	Good	Poor	PFC	~	
3(BLM)	Poor	Good	~	Good	Poor	PFC	~	
4(BLM)	Poor	Good	~	Good	Fair	PFC	~	

6. Summary

The overall risks of cumulative effects are the same as those shown in Table 6 of the biological assessment (BA) of the formal consultation with the U.S. Fish and Wildlife Service (1997). This analysis determined that high temperatures in Lower Deep Creek moved this stream into a high risk for cumulative effects instead of moderate as shown in the BA.

Individual reaches were rated in Table 50. These ratings can be used as a guide for assessing limiting factors for stream channels and improving the channel condition rating. Canopy impacts are estimated to be low when comparing current with reference conditions. Roads have a large effect on the watershed risk rating. Road impacts can be ameliorated as shown in the Recommendations section. Water temperature is the largest limiting factor in the stream channel. Other factors of large wood, pools/mile, sediment and unstable banks affect a stream's overall ratings. Factors affecting these habitat variables are discussed below.

a) Roads and Timber Harvest/Sediment

Extensive logging in the uplands has resulted in high road densities. Roads lead to increased drainage efficiency, creating improved conditions for runoff and sedimentation. The number of stream crossings and roads within 300 feet of the stream channel are high (Synthesis and Interpretation-23). Roads crossing ephemeral streams have been identified as a major source of sediment to the stream system (Bilby et al. 1989). Roads are projected to be a large source of sediment in the stream channel. Prior to development of best management practices and Forest plan standards and guidelines, logging activities often included skidding logs in ephemeral and intermittent stream channels. The amount of LWD in ephemeral and intermittent streams is generally fair or good, however, LWD is considered lower than reference condition due to the effects of logging. Removal of large wood reduced the sediment storage capacity of these channels and disturbed soil that resulted in downstream sedimentation. These disturbances have created the opportunity for sediment to enter the perennial stream system and create increased levels of fines that fill pools and decrease spawning habitat quality. Additionally, roads can result in increased runoff and erosion of the stream channel.

b) Timber Harvest and Grazing/Shade

Stream temperature is a limiting factor in the majority of streams. Seven-day average maximum temperatures varied from 5.9oC to 28.6oC. The State of Oregon standard is a 17.8oC seven-day average. Dismal and Twelvemile Creeks were the only streams that met this standard. Seven-day average maximum temperatures were below lethal levels (26.6oC), except in Lower Camas Creek. Streamside vegetation provides shade to the stream and is a significant factor in the regulation of stream temperatures (Platts 1991). Stream shading has decreased as discussed in Synthesis and Interpretation-25.

Prior to recent Forest plan standards and guidelines, timber harvest occurred along most riparian areas. This reduced large trees. The large tree component consisting of aspen, cottonwoods and conifers provided shade for the stream system and decreased water temperature. Removal of overstory trees has had only a small effect on stream temperature, because overall canopy has generally increased from fire suppression.

Reduced shading due to herbivory by livestock and wildlife has occurred on all perennial streams. The most evident changes from grazing occur at the low gradient stream reaches primarily in alluvial depositional areas (See Map 4). A general observation is that riparian plant communities have been altered in some of these areas to such an extent that local xeric species such as sagebrush and juniper have invaded historic meadow systems, further reducing shade.

Removal of streamside vegetation usually increases summer water temperatures in direct proportion to the amount of increased sunlight on the water surface (Chamberlin 1982). The ability of plants to control stream temperature varies with stream morphology. Grass crowns provide modest overhanging cover and keep much solar radiation from reaching the water, especially along very small streams. Larger streams require higher streamside vegetation to effectively intercept the sun's rays (Platts 1991). Changes from willow sedge to grass and brush are affecting temperatures by providing less shade for intercepting direct solar radiation.

Because shading levels are unknown by specific reaches, determination of potential natural vegetation along with shade monitoring will help to determine areas where shading can be improved. In areas where shade producing vegetation has been reduced, continued improvement toward potential natural conditions will result in improved shade and lower stream temperatures. Historically, many sites had higher levels of shading from willows and overhanging sedges prior to high levels of grazing. Restoring these areas to willow will provide more shade and help maintain lower stream temperatures.

c) Grazing/Channel Condition

The Deep Creek watershed has 20 grazing allotments (Current Conditions-43) which use five different grazing systems: deferred, deferred rotation, rest rotation, early season and season long.

Literature shows that grazing systems affect riparian resources differently. Platts (1991) rates Season Long as the lowest, providing poor conditions for stream bank stability and stream riparian potential. Deferred is rated as poor for stream bank and fair for stream riparian potential. Deferred rotation is rated as fair for stream bank stability and stream riparian potential. Rest Rotation is rated as fair to good for stream bank stability and fair for riparian potential. Early season grazing is not rated, however, experience on the Fremont National Forest shows this is the best grazing system for stream bank stability and riparian potential.

When allotment management plans with grazing systems were implemented, following the intensive livestock grazing that occurred in the late 1800s and early 1900s, riparian conditions began to improve. At present, riparian conditions are on a steady rate of improvement on most lands managed by both agencies. Table 50 showed that of the 35 reaches evaluated for proper functioning condition, 94% were at PFC or on an upward trend (Table 51).

Table 51. Stream Reach Summary of Proper Functioning Condition

	Total Number	Percent of Total
Proper Functioning Condition	24	68
Functioning at Risk with an Upward Trend	9	26
Functioning at Risk with No Apparent Trend	1	3
Nonfunctional	1	3

Water Quality

A. General Discussion

Section 303(d) of the Clean Water Act requires each state to identify streams, rivers and lakes that do not meet State water quality standards. These streams have been included in the EPA 303(d) list (Table 27). Water temperature is the limiting factor that resulted in listing of these streams. Macroinvertebrates are also identified on Burnt Creek. State water quality parameters of dissolved oxygen, bacteria, total dissolved solids and toxic pollutants are not addressed as separate subjects because monitoring data for these parameters are not available.

B. Fine Sediment

Recommended levels of fine sediment vary, depending on the literature source. Levels of 30% are considered attainable as discussed in Reference Conditions-13. Results of instream monitoring and embryo survival rates are shown in Table 28.

On the average, the watershed is within recommended thresholds for fine sediment. However, a reach of Mud and Burnt Creeks exceed recommended levels. Fine sediments in stream substrates are important parameters for salmonids. Both embryos and fry require accessible intergravel voids and adequate water circulation. Also, stream substrate composition is a factor that regulates the production of aquatic invertebrates that process organic material and are an important part of the fish food chain.

1. Fine Sediment from Stream Banks

Channel forming flows of bankfull and greater have increased in frequency in the current time period. This increase, along with unstable banks (in low gradient alluvial depositional areas), is resulting in increased sediment movement. Stream banks in the upper watershed are mostly stable and do not contribute significant amounts of sediment to the stream.

Many of the low gradient alluvial depositional areas have changed to downcut streams that are deeply entrenched Rosgen type F channels. During floods, water moves at high velocity and scours exposed bank material. In proper functioning streams, the floodplain dissipates energy and stream banks remain stable. The downcut streams are now unstable and will proceed through an evolution of meandering and cutting across the entire floodplain. This process will result in the introduction of high amounts of sediment into the stream channel until the stream develops a new floodplain at a new elevation (Rosgen 1994). During this development, streams are continually adjusting for new sinuosity and eroding banks in the process. The eroded bank material is deposited into the stream channels. Historically, wide meadow areas are reduced in size as a result of this evolution process.

2. Fine Sediment from Roads

Roads are contributing sediment to streams. The amount of erosion that becomes sediment is unknown, but estimates are that 10-20% of eroded material can enter the stream as sediment. Sediment entering streams from roads is delivered by processes including surface erosion, mass soil movements, failure of stream crossings, diversion of streams by roads, washout of road fills and accelerated scour at culvert outlets (Furniss et al. 1991).

Road surface erosion has been observed to severely affect streams below right-of-ways (Furniss et al. 1991). The distance that eroded material travels below the hillslope determines the degree of sedimentation in streams. A study of eroded material travel distances below fill slopes shows that more than 95% of the relief culverts can be prevented from contributing sediment to streams if the travel distance is 300 feet or more. Roads with broad-based dips have nearly 100% of the contributing eroded material stopped within a travel distance of 100 feet (Burroughs and King 1989). Additionally, a study on the Medicine Bow National Forest showed that embeddedness and fine sediment increased as culvert density increased (Eaglin 1991).

Table 52 shows road miles within 300 feet of a perennial, intermittent or ephemeral stream. Roads are a major contributor of sediment to stream channels. Maintaining a buffer between the road and stream channel provides a filter that minimizes the introduction of fine sediment into the stream channel. The number of stream crossings and roads within 300 feet of streams were identified from GIS road data. A map of these areas is found in the project file. These are best estimates using GIS and should be ground verified.

Table 52. Roads within 300 Feet of Streams and Road Crossings

Subshed	Miles of Road Within 300 Feet Perennial, Intermittent or Ephemeral Stream	Number of Road Crossings		
		Perennial	Intermittent	Ephemeral
Mud Creek (01)	27	16	32	10
Lower Camas Cr. (02)	25	10	38	21
Horse Cr. (03)	10	3	11	10
Burnt Creek (04)	14	4	11	17
Crane Lake (05)	12	5	11	9
Upper Deep Creek (06)	8	9	1	1
Dismal Creek (07)	13	12	8	10
Willow Creek (08)	13	12	11	11
Cressler Creek (09)	6	5	7	10

Subshed	Miles of Road Within 300 Feet Perennial, Intermittent or Ephemeral Stream	Number of Road Crossings Perennial	Intermittent	Ephemeral
Big Valley (10)	2	1	0	1
Lower Deep Creek (11)	7	2	8	2
Blue Creek (12)	13	3	14	1
Peddlers Creek (13)	8	2	7	2
Drake Creek (14)	~	2	34	2
Gibson Canyon (15)	~	0	1	0
Upper Twelvemile (101)	0	0	0	0
Fifteenmile (103)	3	1	5	3
Twentymile (104)	0	0	0	0

3. Fine Sediment from Upland Timber Harvest

Until recent implementation of the Inland Fish Strategy, stream vegetation buffers specified in timber sale contracts have been minimal to nonexistent. Studies have shown a buffer distance of about one site-potential tree height (120 feet in this watershed) would effectively remove sediment in most situations (FEMAT 1993).

4. Beaver Dams

Beaver dams are important for trapping sediment and providing cool water refugia for fish. Under reference conditions, sediment would be trapped behind beaver dams and cleaner stream substrate would be found below the dams. The decrease in beaver dams has resulted in an even distribution of sediment throughout the entire length of the stream channel and higher levels of fines in spawning substrates than existed historically.

5. Large Woody Debris

Lack of large wood in some stream reaches has been identified as a limiting factor. Typically, large trees have been harvested for timber which has reduced the source of large wood in perennial, intermittent or ephemeral channels. Large wood helps to trap and retain fine and course sediment (Duncan et al. 1987). A study in southwestern Washington shows that approximately 34% of surveyed road drainage points entered mainly first or second order stream channels. Thus, the delivery of road sediment to larger streams often depends on its transport through smaller channels (Bilby et al. 1989). Woody debris has been shown to be extremely effective at retaining sediment in small systems by both slowing water velocity upstream and trapping transported sediment. Large wood provides storage of sediment in the tributaries and contributes to the maintenance of water quality and productive fish habitat (Duncan et al. 1987). Low to moderate sediment levels in perennial streams may be partially due to an adequate supply of large wood in areas of the upper watershed. Large wood is a necessary component of ephemeral, intermittent and perennial streams for storage and sorting of sediment.

6. Sediment Summary

Fine sediments in stream substrate is an important parameter for salmonids. Analysis of stream sediments shows the majority of stream reaches have levels of fines that are in an acceptable range for salmonids.

C. Water Temperature in Perennial Streams

1. General

Except for Dismal, Twelvemile and Rosa Creeks, elevated water temperatures have been identified as a limiting factor on monitored streams. Elevated temperatures are occurring as a result of reduced riparian vegetation from grazing, loss of shading from trees that have been harvested adjacent to the stream channel and widening of stream channels. Higher water temperatures may also be a natural condition where shading was not present in meadows and where beaver dams created higher exposure to direct solar radiation. Factors that affect temperature are discussed below.

2. Riparian Vegetation

Riparian vegetation has changed along perennial streams. Intensive livestock grazing that occurred in the late 1800s and early 1900s resulted in loss of riparian vegetation. At present, riparian conditions are on a steady rate of improvement on most lands managed by both agencies. Tables 50 and 51 show that of the 35 reaches evaluated for proper functioning condition, 94% were at PFC or on an upward trend.

Continued improvement toward historic conditions will result in improved shade and lowering of stream temperatures in areas where shade producing vegetation has been reduced. Also, improved riparian vegetation will result in narrower and deeper stream channels. This change will result in decreased surface exposure to solar radiation decreasing water temperature.

3. Beaver Dams

Beaver dams create conditions of increased groundwater storage. Greater stream bank storage enhances flow during summer months and causes improved distribution of stream flow throughout the year (Olson and Hubert 1994).

Beaver ponds warm stream temperatures as water passes through a series of ponds. However, beavers improve riparian habitat by enhancing subirrigation of adjacent land, by elevating water tables and expanding wetland areas. Elevated water tables enhance growth of deciduous woody vegetation that provides shade. In the Rocky Mountain Region, elevated temperatures downstream from beaver dams has seldom exceeded tolerable high water temperatures for trout (Olson and Hubert 1994). Temperature monitoring on the Fremont National Forest showed that temperatures above and below beaver dam complexes in meadows did not increase temperatures to lethal levels. Temperature increases were equal to or less than temperature increases through systems without beaver dams (Friedrichsen, personal communication). However, data from the Silver Creek Watershed Analysis indicate that stream temperatures may occur naturally that exceed State of Oregon standards in these systems.

Beaver ponds may have resulted in some localized areas where State of Oregon standards were exceeded for stream temperatures. However, beaver ponds can provide deep water habitat with cool refugia areas. Loss of beaver dams has created streams that are less complex with less cool water refugia. Under these conditions, temperatures are more evenly distributed with less influx of cooler water for refugia.

4. Summary of Stream Temperature

Water temperatures in all of the streams except Dismal, Twelvemile and Rosa Creeks exceed State of Oregon standards. Further intensive monitoring to determine the locations and possible causes for elevated stream temperatures will be needed for site-specific recommendations. It is not known if State of Oregon recommended thresholds of 17.8oC are attainable. However, shading was more prevalent in historic conditions prior to channel widening and loss of shade from degradation of riparian vegetation. Therefore, it is assumed that shading can be increased, banks can be narrowed and temperatures can be lowered from existing conditions.

D. Macroinvertebrates

Species of macroinvertebrates vary greatly depending on water quality within a stream. The macroinvertebrate biotic index (BCI) provides general information regarding the integrity and health of stream systems (Table 30). The water quality trend, as it relates to macroinvertebrates, is an overall decline in habitat conditions in Willow Creek, with Burnt Creek remaining in poor condition. These ratings primarily occurred because of high sediment tolerant species. Current conditions showed some organic enrichment. There is a data gap regarding the level of organic enrichment. This supports the need to reduce erosion and sedimentation and improve riparian vegetation as a filter.

Deep and Twelvemile Creeks decreased in the BCI rating. Parsnip and Camas Creeks remained the same. Current conditions showed that slight to moderate organic enrichment occurred at the sites. There is a data gap regarding numeric values and sources of enrichment and levels of sediment.

<u>Species and Habitats</u>

A. Terrestrial

1. Threatened, Endangered, and Sensitive Species

a) Northern Bald Eagle (Threatened)

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 have reduced the abundance, distribution and quality of potential bald eagle nesting/roosting habitat on the landscape since 1950. Overstory, partial removal and regeneration timber harvest treatments in LOS ponderosa pine have removed preferred nest/roost trees and fire suppression has resulted in an increase in stand densities contributing to mortality of the large overstory trees 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. Plant succession is also causing a change in plant species composition in many stands from true pine to mixed conifer which is less suitable for nesting/roosting.

Prey habitat suitability has been marginal within the watershed during both historic and current time periods.

b) American Peregrine Falcon (Endangered)

American peregrine falcon establishment is dependent upon prey availability of marsh-related species, as well as, terrestrial small mammals and birds. Marsh birds are most abundant during wet cycles that occur about three in ten years in southeastern Oregon. During drought years, waterfowl and shorebird numbers are low and any nesting peregrines would have to also prey on small mammals and birds. Small mammal populations are cyclic with explosions and crashes and are currently rebuilding after a crash in population two years ago.

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 a low.

Timber harvest treatments that opened the forest canopy have gradually increased foraging habitat suitability in all forested subsheds. However, habitat for prey species and hunting will diminish as 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. Large fires that remove forest overstory are likely to be more common in the decades to come given the acres of stands in a dense vegetal state where the risk to stand-replacement fire is high. Predicted reductions in road densities will reduce disturbances and increase habitat security within potential habitat.

c) Western Sage Grouse

Sage grouse habitat was maintained by wildfire prior to Euroamerican settlement. Fire suppression and livestock grazing have changed this habitat dramatically. Fire suppression has allowed sagebrush to dominate sites and replace areas previously occupied by grasses and forbs. This change in plant composition and structure has not benefitted 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 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.

d) California Bighorn Sheep

California bighorn sheep habitat has also 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 still exists between cattle and bighorns. Bighorn sheep utilize steep, rugged terrain inaccessible to cattle for foraging and lambing. However, competition for forage and space can occur if bighorns expand to new areas and water is limiting within the rimrock itself.

Fire suppression has created climax sagebrush communities with limited grass/forb production. Wildfires caused by lightning maintained the bunchgrass communities important to foraging bighorns, especially bluebunch wheatgrass. Livestock grazing and fire suppression have changed the native perennial bunchgrass to native and nonnative annual grasses which are not used as much by California bighorn sheep.

2. Keystone Species

a) 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 that have cumulatively altered the landscape. Drought and insects and disease in recent years are currently making additional modifications to all seasonal ranges and migration corridors in all ownerships.

Prior to 1950, big game ranges were partially maintained by natural wildfires that created a mosaic of successional stages from early to climax. This provided a vigorous supply of winter browse, cover and early green-up grasses and forbs necessary for reproduction and survival.

Fire suppression as a habitat change agent since 1910 has created an unnatural condition in that it benefitted browse species such as antelope bitterbrush and curl-leaf mountain mahogany in the short-term by protecting stands from fire, but in the long-term it created evenaged decadent stands with little or no reproduction or vigor. Fire suppression has also allowed western juniper woodlands to establish in areas where juniper was a minor component of the landscape. In the absence of natural wildfires, juniper has expanded at the expense of the understory shrubs, especially antelope bitterbrush, and native herbaceous species. Natural fire regimes maintained stands in a mosaic of plants in various age classes and allowed vigorous growth and seedling establishment.

Livestock grazing, drought cycles, and insect outbreaks have also negatively effected 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. BLM livestock management plans have reduced conflicts between livestock and wildlife by limiting livestock numbers and season of use. The drought cycles that occur periodically further limit grass/forb production and browse seedling establishment. Insect infestations also contribute to the decline of browse species by limiting flower and seed production and affecting the overall vigor of plants.

The loss of riparian deciduous vegetation (willows, aspen and shrubs) and lowered water tables in riparian zones as a direct result of overgrazing through the early 1900s has altered the abundance and distribution of fawning/calving and rearing cover and forage. Recovery of riparian vegetation is gradually occurring around many stream and spring areas under present livestock management and should benefit deer and elk, as well as, pronghorn kidding and foraging (forbs) habitat.

The amount and distribution of effective cover currently exceeds optimal levels in most areas within the forested portion of the watershed. Since cover/forage ratios were not available for the historic condition, the relationship between historic and current conditions is not specific. It can be assumed that more frequent fires historically allowed more forage habitat. Fire suppression throughout the twentieth century has caused a transition in stand structure from more open to more dense understories. Fire suppression has also precluded creation of short-term forage areas. While forage areas were created by timber harvest activities, creation of openings has not occurred on a large scale since the late 1980s. Most man-created forage areas have since reforested and are transitioning to a state of cover. The lack of forage will become even more pronounced in the next several decades with large-scale wildfires and insect outbreaks creating the only forage habitat. Prescribed fire is a tool that can be used to restore foraging habitat on a more predictable schedule.

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. If road closures and obliterations are implemented, habitat availability and security will increase.

Rocky mountain elk populations are expanding and will continue to grow in numbers unless harvest can control the population at the management objective of 500 animals. At the current population no negative impacts to the mule deer herd or major competition with domestic livestock exists. However, as the population expands to 500 animals there may be competition for grass forage with cattle and additional stress put on winter browse used by deer and elk. More elk could potentially reduce the carrying capacity for deer and precipitate a slow decline in deer numbers and distribution. This condition may require readjustments in livestock/wildlife AUMs.

b) 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 shade tolerant 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 to the extent that beaver habitat needs for water and food may no longer be met in some stream systems. Upland timber harvest and road construction have contributed to altered runoff and stream flow regimes to the detriment of favorable beaver habitat conditions.

Trapping harvest and transplant records indicate that direct removal of beaver from the watershed 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 still in effect has probably protected beaver populations.

As beaver are lost from the system, wetland habitat is reduced along with associated plant and animal diversity and productivity, water and sediment storage and transport are altered, and nutrient cycling and decomposition dynamics change.

Recent riparian recovery, where willow and other deciduous riparian species are limiting population growth, has benefitted beaver populations in local areas by allowing them to occupy new areas and be more productive in areas where they have existed since historic times.

c) Nongame Species

Shrub-steppe dependent nongame species have declined in distribution and numbers from livestock grazing, fire suppression and plant succession. The natural mosaic of shrublands in a variety of seral stages maintained by wildfire has been allowed to convert 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 should allow some recovery of upland shrub-steppe habitat. Full recovery may require the introduction of fire.

Riparian-dependent species have also demonstrated declines in distribution and abundance with the loss of riparian woody vegetation. These species will benefit from current livestock management and future aspen/cottonwood management.

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

a) General

Based on historic and current estimates, total acres and continuity of LOS forested stands are currently less than what occurred historically (Table 42). Acres and patch size of interior LOS have declined as well. Table 34 shows average LOS interior patch size being only 22 acres, where 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 and, to a lesser degree, wildfire. Insect and disease outbreaks, blowdown events, firewood cutting, hazard tree removal, road construction, and in some instances fire suppression also have contributed to the loss of habitat. These disturbance agents have removed large diameter live trees, snags and down wood, 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. Wildfire has generally increased the amount of dead wood habitat over the burn area, but follow up salvage treatment removes most of the large dead wood from the area.

True ponderosa pine has 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 now characterized as mixed conifer with more shade tolerant, dense white fir understories. Also, 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 has most likely declined from historic levels.

Succession of forest cover above 6,500 feet and on warm 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 associated species such as black-backed woodpecker.

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 as 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 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 improved stand conditions which presently exist 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. Fewer marten could mean higher rodent populations which damage or kill tree seedlings. 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.

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 never again be a part of the landscape. Forest habitat that matures on private lands in the future probably will be harvested before it develops LOS forest characteristics, and will always be marginal sink habitat for MI and other species associated with LOS forest and dead wood habitats. Potential forest regeneration treatments on private lands in the future could continue to create edge habitat for goshawk prey species.

On forest lands, LOS forest and dead wood habitat should gradually increase in abundance, continuity, distribution and quality over the long term as forest management shifts to longer rotation unevenaged treatments and tree plantations grow into mature forests. Smaller openings created by future unevenaged treatments could create more suitable prey and hunting habitat for goshawks and marten. 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. However, as plantations grow into the mid-seral condition class, habitat conditions for goshawk and marten prey species will decline. Road closures and obliterations will help reduce habitat fragmentation. Sanitation/salvage harvest prescriptions and underburning will continue to reduce dead wood habitats, but sufficient snags and down wood should be protected and created through insects and disease and wildfire to maintain stable populations of most dead wood associated MI and other species.

Prescribed underburns and thinning as now proposed should 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 wildlfire. 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.

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, predicted road closures/obliterations and lower levels of timber harvest activities in the future should reduce disturbances to LOS forest habitat and associated species.

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 is evident 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, more acres of LOS mixed conifer forest should be present in the future. Overall, the future abundance and distribution of wildlife species associated with LOS forest habitat, especially ponderosa pine, will be less than occurred historically.

b) Red-naped Sapsucker

Aspen is gradually being replaced by conifers over time primarily as a result of plant succession and fire suppression. 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 has resulted in a decrease in aspen regeneration. The regeneration that does occur is 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 permanently lost.

As aspen disappears from the landscape, preferred habitat for beaver, red-naped sapsucker and other aspen associated species is lost and wildlife habitat and diversity will decline. Population levels and distributions of these species will decline as a result. To help maintain wildlife numbers, management actions such as the current grazing strategies implemented for Section 7 consultation for the Warner sucker must be implemented and complied with to halt the gradual loss of aspen from the landscape and restore its presence to areas that historically supported aspen. The reintroduction of fire will be needed along with aggressive conifer management to restore and maintain these stands.

Stands that are currently regenerating in areas where livestock are excluded hold promise for successfully transitioning to later structural stages.

B. Aquatic

1. General

The redband trout can be found in a variety of habitats depending on its life stage. Adults are generally found in areas of abundant cover associated with deep pools, large organic material, undercut stream banks and overhanging vegetation. Juveniles and young-of-the-year are often found in shallow stream margin habitats, high cover areas and interstitial substrate spaces. The redband trout is a spring (March through June) spawner with eggs usually hatching in four to seven weeks, then taking an additional three to seven days to absorb the yolk before becoming free swimmers (Sigler and Sigler 1991). The average age at first spawning is typically two to three years. Redband trout up to 12 inches in length require access to spawning gravels of up to 2.5 cm in diameter with less than 30% fine sediment. Generally, water temperatures in excess of 21oC (70oF) are unfavorable and may cause stress to all age classes (Sigler and Sigler 1987). Temperatures in excess of 25oC and 29.4oC have been shown to be lethal (Bjornn and Reiser 1991). Temperatures of about 15oC (58-69oF) are ideal for optimum growth of rainbow trout (Leitritz and Lewis 1980).

The term limiting factor relates to those factors that have or continue to limit redband trout populations. Habitat needs of redband trout were selected to assess limiting factors within the watershed because it is believed addressing these factors will provide healthy, stable aquatic ecosystems that meet the needs of all aquatic dependent species.

2. Barriers

Barriers consist of waterfalls that divide upper and lower stream reaches of streams to fish movement (Current Conditions-41). It appears from fish presence data that there are no barriers to brook trout or stocked hatchery fish to prevent their upstream movement into the headwater sections of streams.

Weirs are located on private property. The status of the weirs are unknown with regards to fish barriers.

Few culverts have been noted as a barrier to fish passage, however, site specific information on the majority of culverts with regards to fish passage is unknown.

3. Spawning and Incubation Habitat

Spawning habitat ranges from good to poor. According to Behnke (1992), spawning success may be severely limited in low gradient areas where reproduction is typically restricted by high sediment loads that blanket redds with silt during spring runoff.

The filling of interstitial spaces with fine sediment reduces oxygen flow to the redd, which reduces egg incubation success and alevin survival (Young 1989). Fines can also act as a physical barrier to fry emergence (Weaver and White 1985). Salmonids are dependent upon aquatic invertebrates for food. Fine sediment covers food production areas in rubble and gravel areas, reducing aquatic insect habitat and in turn reducing the quality and quantity of food available to salmonids. Accelerated erosion can favor populations of fall spawning, nonnative brook trout over native trout. This is the case in a few streams that have fines in excess of the 30% threshold in the redd habitat areas (Mud and Burnt Creeks).

Fine sediment is also high in Willow (29%) and Lower Deep (28%) Creeks. Table 28 identifies that substrate fines range from four to 40% within perennial streams. Mean values of substrate fines and embryo survival rates also are shown in Table 28.

Sampling of stream substrate within potential redd areas shows that the percentage of gravel in the substrate is generally adequate and is not a limiting factor in the stream channel. Flushing of fines would result in adequate supplies of gravel above 6.4 mm in size.

Factors that affect fines have been discussed in Synthesis and Interpretation-22 to 25.

4. Low Flows

Spring spawning trout like redband will use intermittent streams for reproduction (Behnke 1992). The use of intermittent streams by redband trout has been documented within the Klamath River watershed on Bly Ranger District (Nichols, Personal communication). The success of this spawning strategy is largely dependent upon sufficient water in tributaries to allow spawning trout to access the intermittent streams through road culverts and for young trout to move downstream to the mainstream.

Evaluation of Deep Creek gauging records shows that mean spring runoff in the form of peak flows has increased over historic conditions, but this should not have effected spring spawning in intermittent streams.

There are few active side channels along perennial streams in low flow conditions, particularly along entrenched channels. Rearing habitat is considered to be limited because water is mostly confined to the thalweg portion of the stream during low flow periods and there are few side channels. Historic beaver dams created backwater habitat for rearing. Loss of the beaver dams has resulted in reduced backwater rearing habitat.

Loss of beaver dams also can decrease base flow. Loss of base flow negatively effects pool rearing habitat. Less water in late summer and winter further reduces residual pool depth which concentrates fish and magnifies negative impacts.

5. Pools

Pools are important summer and winter habitats for both juvenile and adult trout (Decker and Erman 1992). Generally, the number and frequency of pools in a stream are a good indicator of the overall quality of the habitat to support trout populations. The frequency and depth of pools is dependent upon the geomorphic character of the stream bed, flow and balance of the sediment supply. Pool frequency was measured as fair to good in all streams except Deep Creek Middle Fork, Mud, Parsnip, Polander and Burnt Creeks.

Generally, pool habitat has been lost by pools filling with sediment. Several factors have contributed to this occurrence. One of the major factors occurred when beaver were trapped and abandoned beaver dams failed. These riparian areas were then grazed and stream channels were downcut with narrower floodplains. Lower gradient streams have changed from historical Rosgen type E channels to wider and shallower Rosgen type C or F. Widening of the stream channel has resulted in loss of deep pool habitat. Also, sediment is produced from erosion caused by unstable stream banks, roads, logging impacts and from loss of large wood. Loss of wood in intermittent and ephemeral channels results in sediment being quickly transported downstream to perennial reaches.

Deep pool habitat is identified in the ICBEMP as pools that are greater than 2.6 feet in depth. Polander and Willow Creeks showed poor deep pool habitat. Both of these streams also showed poor large wood ratings and they are also within areas that have higher road densities. This indicates that a lack of large wood and the influence of sediment from roads may be contributing to loss of pool depth.

Streams rated with poor deep pool frequency are most susceptible to freezing. During winter months, reduced pool depth along with colder water temperatures and increased stream bed disturbance form ice scour and gouging can stress fish. Maintaining conditions that provide deep pools is an important component during the winter months.

6. Large Woody Debris (LWD)

All streams rated for LWD content had some poor ratings except Parsnip, Roaring Spring Fork of Drake and Lower Deep Creeks. Both Parsnip and Lower Deep Creeks did not have potential for large wood due to a natural lack of suitable material. Other sites with low ratings should be field verified to determine if they have potential for large wood.

Large wood in perennial streams provides hiding cover, sorts gravels, produces aquatic insects, creates pool habitat and hydraulic refuge (Sedell et al. 1989). Large wood in ephemeral and intermittent channels slows erosion and fosters deposition of organic and inorganic materials. Deposited material becomes a source of food for macroinvertebrates both on site and downstream.

The amount of large wood within most of the intermittent and ephemeral streams is unknown. It is assumed that the large wood in perennial streams can be extrapolated to intermittent and ephemeral streams. Therefore, some of the streams have potentially low LWD. The consequence of this poor rating for large wood in intermittent and ephemeral channels is that sediment which may normally be trapped in these streams is now quickly routed to the perennial streams below where primary fish habitat is affected. However, low to moderate sediment levels may be partially due to an adequate large wood supply in areas of the upper watershed.

Loss of large wood in perennial streams also is contributing to loss of pool habitat.

7. Stream Bank Condition

Natural surface erosion outside of the stream channel and erosion of stream banks occur over a prolonged period but, under natural conditions, are usually in balance with the bank rebuilding process. Land management activities (i.e. livestock grazing, timber harvest and road construction) can alter this equilibrium resulting in significant increases in bank erosion and channel instability (Platts 1991). Bank instability reduces rearing habitat for younger fish by eliminating undercut banks that provide cover. Adult habitat also is affected by loss of undercut banks which provide pockets of cooler water during the heat of the day for fish to occupy.

Bank stability has not been measured on forest stream reaches except for South and Middle Forks of Deep Creek. However, Lower Deep Creek , Parsnip and Camas Creeks on BLM exceed the recommended threshold of 20% bank instability.

8. Shade

Streamside vegetation provides shade to the stream channel which is a significant factor in the regulation of water temperatures (Platt 1991). The ability of vegetation to shade a stream is dependent upon the general morphology of the channel, channel orientation to the sun, and the condition and type of streamside vegetation. For example, the amount of shading a stream receives is often greater in narrow steep sided canyons or those streams which flow east or west as compared to those in wider unconstrained channels or which flow north or south. Larger streams require higher adjacent streamside vegetation to obtain adequate shade. Platts (1991) found trees provided nearly all of the stream shading on large streams (6th and 7th order) and shrubs and trees on small to medium sized streams. The condition and type of vegetation also affects shade levels. Both canopy density and closure are important factors affecting stream shade (Adams and Sullivan 1990). On forested streams, the effective buffer width varies based upon ecotype but most shade is provided by vegetation within one potential tree height of the stream channel (FEMAT 1993).

Excessive herbivory by livestock and other ungulates has lowered the water table along stream channels, particularly in the lower gradient deeper soil riparian sites. This primarily occurred from overgrazing in the late 1800s and early 1900s. Channels on the upper reaches of streams and canyons were less affected by grazing because of greater rock content and inaccessibility to stock. The greater quantity of rock material resists downcutting. Downcutting alters streamside riparian vegetation, which is now dominated by sagebrush and xeric species. In many cases, the stream width to depth ratios have changed from narrow deep channels to wider shallower channels.

Stream temperatures have a strong influence on redband trout populations (Synthesis and Interpretation-32). Redband trout that have evolved in the closed basins of eastern Oregon generally have higher temperature tolerances than rainbow trout elsewhere in the United States. Stream water temperatures within the Deep Creek watershed have exceeded the 70oF (21.1oC) threshold for rainbow trout on perennial streams as shown in Table 29. Approximately 77% of the streams monitored exceeded 70oF.

9. Interspecific Competition

The level of stress on native redband trout from the stocked brook trout is not known. However, competition is assumed to be an important factor that is limiting redband trout populations.

Human Uses

A. Timber

Timber harvesting conducted by Fremont Sawmill on private lands and the Forest Service's increased harvesting of big ponderosa pine following the end of World War II has left a visible impact on the forest landscape throughout the watershed. Besides the removal of the big trees, road building and other timber related ground disturbances can be seen.

Up until World War II, timber harvest had been limited and most of the timber had gone to local markets. The style of cutting was more of a "PICK and PLUCK" than anything else and left a natural appearing forest when harvesting was completed. After World War II, the increased demand for wood products caused a more accelerated harvest situation which slowly began to change the appearance of the natural landscape.

Harvest levels on National Forest System lands held steady and increased to a peak in the 1980s. After this, harvest levels dropped off to about one-tenth of this peak level.

B. Grazing

As the nineteenth century came to an end, homesteaders who built at 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 this century, sheep and cattle grazed heavily throughout the watershed. It wasn't just their vast numbers, but the fact that they grazed year-round that had such an effect on the watershed's vegetation. After the Taylor Grazing Act of 1934 and World War II, domestic livestock grazing declined. Gradually, sheepherding gave way to cattle production and today the cow is the dominant commercial grazing animal within the watershed.

The impacts of grazing management on BLM-administered lands in the watershed are addressed in the following allotment discussions.

Vinyard Individual Allotment (0201)

This allotment encompasses portions of Lower Deep Creek and Gibson Canyon subsheds. There is a detached pasture in Drake Creek subshed. Management is a three pasture rest rotation grazing system that has been in place for 25 years. The allotment is currently undergoing an evaluation to determine what changes if any should be made in the grazing management.

In the past 10 years, major changes in allotment management have resulted in watershed improvements. About 8.1 miles of the 8.5 miles of Deep Creek have been excluded from grazing except for four small watergaps along the creek. This significantly reduced the impacts from grazing on Deep Creek and should continue to improve the riparian vegetation for several years. Only 0.4 miles of public land and 0.75 miles of private land along Deep Creek remain open to cattle grazing and these portions are only grazed for part of the year. In addition, the 1.7 miles of Camas Creek and 0.5 miles of Drake Creek are excluded from grazing.

The areas of concern on this allotment continue to be Sweeny Canyon and Squaw Creek which are intermittent but heavily used when cattle are in these pastures. These drainages are in separate pastures that are grazed early in the spring and summer every other year. The new grazing plan is to graze these areas a little later in the season thereby reducing the grazing period and utilization levels.

There are significant areas of big sagebrush-grass in the Gibson Canyon subshed that have become juniper-big sagebrush with juniper encroachment from the rims above. Juniper control should become a major component of future management to maintain a diversity of plant communities.

Hickey Individual Allotment (0202)

This allotment encompasses portions of Drake and Peddlers Creeks, Big Lake and Gibson Canyon subsheds. The allotment has a five pasture rest rotation grazing system in which two of the pastures are riparian pastures. These riparian pastures are Camas Creek and Parsnip Seeding. The schedule for both pastures is spring grazing (April-May) for two to six weeks every other year with rest during the other year. This system has been in place since 1994 and conditions along the 1.9 miles of Camas Creek and the 1.0 mile reach of Parsnip Creek have been improving steadily. Utilization levels have reached 70% along the creek when it is grazed, but moving livestock off before June has allowed for plenty of regrowth. The stubble height has been a minimum 8-10 inches by fall. This grazing schedule has eliminated cattle grazing on willows and young willows are starting to establish. There is also a 0.5 mile of Drake Creek and 1.4 miles of Parsnip Creek that are excluded from grazing except for two small watergaps. This exclusion has helped improve these riparian areas significantly.

The other three pastures are upland pastures grazed in a rotation pattern designed to rest one pasture a year. The primary vegetation in these pastures is low sagebrush-grass in late and mid-seral condition. There is some big sagebrush-grass in early seral condition and some with cheatgrass in the understory. Under the current grazing system, these communities have been improving. However, young junipers have invaded some of the big sagebrush-grass from sources on the rocky rims. Some control of these junipers may be necessary in the future.

Crump Individual Allotment (0204)

This allotment is within the Gibson Canyon subshed. Only the southern tip of the allotment (600 acres) is in the watershed. The public land is grazed every year early in the spring to utilize the cheatgrass and then rested to allow perennial grasses to maximize growth.

Lane Plan II Allotment (0206)

Most of this allotment is in the Big Lake subshed. The allotment is a three pasture rest rotation system with one of the pastures being a crested wheatgrass seeding. Each spring one of the native pastures, either Thompson or Crump Lake, is grazed and the other one rested. Then, the Parsnip Seeding pasture is grazed for two to three weeks in June. Drake Creek forms the boundary between Thompson and Crump lake pastures, but Drake Creek is excluded when the cattle are in Crump Lake pasture. When the cattle are in the Thompson pasture, about 1.5 miles of Drake Creek can be grazed and about 1.25 miles is inaccessible. The grazing system allows for grazing during April and May when the water is high and the canyon bottom is cold. This limits the amount of the creek area the cattle can access and the time they spend there. By removing the cattle before June there is adequate time and water for grazed vegetation to regrow and stubble heights have exceeded the required six inches by fall. Grazing use on willows also is minimal this early in the spring. Riparian conditions are improving on Drake Creek. The Roaring Springs Fork which runs from Roaring Springs for 0.75 miles into Drake Creek is managed the same as Drake Creek.

There is a short reach of Parsnip Creek within the Parsnip Seeding pasture but it is excluded from grazing except for a small watergap.

The uplands sites in the Thompson and Crump Lake pastures are a mixture of low sagebrush-grass and big sagebrush-grass with some significant areas of juniper invading the big sagebrush. The Thompson pasture especially has a lot of young (less than 100 years old) juniper present and a prescribed fire may be necessary to prevent this area from becoming a solid juniper stand.

Lane Plan I Allotment (0207)

There are portions of five pastures within the Lower Deep and Cressler Creek, Big Valley and Gibson Canyon subsheds. This allotment operates under a rest rotation grazing system that rests two pastures each year.

There are no perennial streams within the allotment though Squaw Creek, an intermittent stream, is a tributary of Deep Creek. Under this grazing system, Squaw Creek has been grazed for a few weeks and has been rested three of the last five years.

The grazing system is well suited for the upland vegetation present as most of it is low sagebrush-grass and juniper-low sagebrush-grass.

Sagehen Allotment (0208)

Most of the allotment is within the Lower Deep Creek subshed with some in Crane Lake and Drake Creek subsheds. There is only the Deep Creek riparian pasture and the Sagehen pasture in this allotment. Grazing management is flexible as this allotment is used in conjunction with the Hickey 0202 allotment. The plan is to graze the Deep Creek riparian pasture as early in the season as possible and be off during July. In addition, there is a 5" stubble height requirement along Deep Creek. This plan has worked well since 1994 and the riparian vegetation along Deep Creek has been steadily improving. The amount of herbaceous vegetation has increased and there are new willows establishing.

The upland vegetation in this allotment is in an upward trend and much of it is already in late seral condition.

Schadler Allotment (0209)

This allotment is almost entirely within the Crane Lake subshed. About half of the BLM-administered land, which is mostly low sagebrush-grass, is in late seral condition and half is in mid-seral condition. Grazing occurs in the spring and fall on the way to and from Forest Service allotments.

Lynch-Flynn Allotment (0520)

A portion of two pastures from this allotment are in the Big Lake subshed. There are no perennial streams flowing through the allotment. The allotment is grazed spring and summer under a rest rotation grazing system. This system is effective for the low-sagebrush-grass and scattered big sagebrush-vegetation found here.

National Forest

The present grazing program on the Lakeview Ranger District within the boundaries of the Deep Creek watershed show 2,336 cattle permitted to graze eight allotments during a general season of 7/1 to 9/30. As a comparison, between 1909 and 1915 on one allotment alone, there were 6,510 head of sheep permitted for four months 6/15 to 10/15. At the same time, there were 572 head of cattle and 61 head of horses permitted for seven months 4/15 to 11/15. At this time, there were no grazing systems and the stock was moved when the area was grazed out. The impacts of this intense historic livestock grazing are described by Deputy Forest Supervisor Bradley in Synthesis and Interpretation-4. Now, of the eight allotments, five are grazed under a deferred rotation system, one is under a rest rotation system and two are season long. Of the two season long systems, one allotment has 75 head for 60 days and the other allotment is under on-off and private land permits.

Riparian areas that currently are or recently have been degraded due to livestock grazing activities have been fenced into riparian pastures for protection and controlled use by livestock. At this time there are six such pastures. They are: a 498-acre pasture on Dismal Creek; two pastures on Deep Creek, totaling 152 acres; a 40-acre pasture on Willow Creek; a 480-acre pasture on Camas Creek; and a 80-acre pasture on Burnt Creek. In 1996, sites photographed 30 to 50 years ago were rephotographed to record any change. The main change is new willow growth in riparian areas.

Since 1995, the grazing monitoring program to assure compliance with the biological opinion for the protection of the federally listed Warner sucker has shown few incidences of noncompliance. There were three such incidences in 1997. For the most part, forage utilization in key areas of the allotments did not approach the maximum utilization standard. Presently, all allotments in the Warner Mountains, including those in the Deep Creek watershed, are being evaluated for grazing activities. Any recommendations from this process to improve watershed condition will be considered for implementation.

STEP 6. RECOMMENDATIONS

The purpose of Step 6 is to provide management recommendations based on the ecosystem analysis process performed in the previous 5 steps. Monitoring activities are identified that are responsive to the issues and key questions. Data gaps and limitations are also identified.

Interdisciplinary analysis of the watershed was used to establish treatment priority areas (Maps 9-13) and recommendations. Some recommendations, such as use of prescribed fire, should be applied over large areas such as a subshed. Other recommendations, such as those relating to riparian areas, may be very site specific. Recommendations for improving conditions are divided into five categories as follows: Erosion Processes/Hydrology, Vegetation, Water Quality, Aquatic Resources/Stream Channel, Species and Habitats and Human Uses.

The goal of these recommendations is to guide the general type, location and sequence of appropriate management activities within the watershed based on the analysis. The objectives of these recommendations are to:

1) Reduce soil erosion and improve soil productivity and water quality.

2) Increase the overall vigor of forest stands.

3) Create vegetative patterns that more closely resemble the range of vegetative patterns that would occur based on the inherent disturbance regime.

4) Create vegetative conditions that enhance the many uses that occur.

5) Improve riparian ecosystems.

6) Improve hydrologic function and channel conditions.

7) Maintain and/or improve terrestrial and aquatic species and their habitats.

8) Provide for human needs.

Erosion Processes/Hydrology

A. Soil Resources

Meet Forest plan and BLM Healthy Rangelands standards and guidelines for detrimental soil impacts on a cumulative effects basis. Emphasize treatment areas identified on Map 10. Subsoil, seed, fertilize and mulch where necessary to reduce compaction and increase infiltration. Seed with native species as appropriate and depending on availability.

> Reason: Soil impacts are estimated to exceed Forest plan standards and guidelines, i.e. 30-45%, by as much as 200% in some areas. Compacted soil in timber harvest units has been identified as the greatest soil resource impact. Reduced infiltration from soil compaction affects vegetation growth and hydrologic functioning of the watershed.

Increasing infiltration by subsoiling would restore soil productivity and decrease accelerated drainage from compacted soil.

B. Road Management

High open road density is a critical issue for the area. Transportation system planning and access to timber stands should be initiated for the watershed. A comprehensive transportation system plan, logging system plan and access schedule is needed for all timber stands as well as other resource values such as recreation and fire protection. The ability to accomplish any restoration or resource management objectives depends on the transportation system and access management. Impacts to soil resources, stream sedimentation and disturbance to wildlife and their habitats must be reduced to maintain or increase resource productivity.

1. Road Density (Applies to Element 3 of WQMP)

Road management should emphasize rehabilitation of existing roads to provide cross drainage and reduce compacted soils. It should also emphasize closing roads to reduce open road densities. If roads are needed in the future, use closure with adequate cross drainage in lieu of road obliteration. Closed roads should be treated for the entire road length at the time of closure. Open road density on deer and elk seasonal ranges should be managed within 1.0 to 2.0 mi/mi^2 in accordance with recommendations from the Interior Columbia Basin Ecosystem Management Plan to provide habitat security conducive to the resident deer population and the expanding elk population.

Reason: Reducing the open road density will help meet wildlife security needs, reduce soil erosion and sedimentation, lower peak flows and delay seasonal runoff, improve spawning substrates and create less stream bank erosion from unnaturally high flows.

2. Road Obliteration (Applies to Element 3 of WQMP)

Obliteration implies the utilization of a subsoiler or tracked excavator to obliterate the road prism and restore the natural hydrologic flow of the hillslope. Subsoiling is the shattering of the compacted roadbed to restore soil condition. A minimum of 80% of the entire roadbed should be in a shattered condition. **The pattern of subsoiling should be a J-hook that results in a water bar and allows water to drain off the road and back to an undisturbed soil surface**. Spacing of J-hooks should be those recommended below for drainage structures. On obliterated roads and trails which are not outsloped and J-hooked, water bars should be constructed at the spacing shown below. Also utilize blocking, erosion seeding and logging slash where feasible to help control access and minimize erosion. Emphasize road obliteration within 300 feet of perennial, intermittent and ephemeral streams.

Reason: Roads have been shown to contribute to the hydrologic efficiency of the watershed by providing high drainage densities and increased drainage efficiency. Subsoiling of roads and providing frequent drainage onto the upland soil areas will restore soil productivity and decrease runoff efficiency. Water will move through the soil at a natural rate, remain in the uplands longer into the year and be available later in the season for stream flow.

□

3. Cross Drainage (Applies to Element 3 of WQMP)

Provide the appropriate number and spacing of cross drains on skid trails, skid roads and temporary roads. Table 53 is a guide for cross drain spacing.

Table 53. Cross Drain Spacing

Gradient Percent	Cross Drain Spacing (Feet)
0-5	200-160
6-10	160-120
11-15	120-100
16-20	100-60
21-30	60-40
31-45	40-25
46+	25

Roads that will have continued use should have broad-based dips constructed. Dips should be installed on a spacing recommended in the Fremont National Forest Guide to Erosion Control on Forest Roads and Trails (Spacing = 400 feet/%Slope +100 feet). Broad-based dips should be designed with an adverse grade on the downhill side and, where possible, should be armored with aggregate to prevent traffic from cutting through the structure.

Roads that are blocked at the entrance should also have drainage structures installed along the entire length of the road. Broad-based dips or water bars are recommended on the spacing of 400 feet/%Slope +100 feet. Culverts should be pulled or inventoried and maintained on a schedule.

> Reason: Providing the appropriate cross drain spacing on roads and skid trails will help to keep water and eroded soil in the uplands. This will improve water quality by reducing unnaturally high levels of sediment and maintaining water longer in the uplands to be used by vegetation and be available for stream flow later in the season.

4. Buffers on Roads

Emphasis should be placed on buffering roads with culverts and getting water off of the road prior to ephemeral, intermittent or perennial streams. A 300-foot minimum buffer area between the stream channel and road is recommended. This distance can be reduced to 100 feet for roads with broad-based dips and for roads along intermittent nonfish-bearing streams and ephemeral streams. Individually, evaluate roads within 300 feet of streams to determine if subsoiling is necessary. Roads that are well revegetated and well drained may not require subsoiling within this zone. However, it is expected that most roads in this zone will require subsoiling. Emphasis should be given to perennial streams with numerous stream crossings.

> Reason: Studies have shown that most sediment from roads is trapped within 300 feet of roads with culverts and within 100 feet of roads with broad-based dips. Obliterating roads within the above ranges and reducing road crossings would eliminate the majority of road related sediment to stream systems.

C. Canopy Cover

Coordinate with silviculturists and wildlife biologists to treat forested areas that have dense understories of conifers and high basal area. As much as possible, stay within the historic range of variability for canopy cover over areas of 1,000 acres or smaller. Discourage clearcutting except in small patch cuts or where absolutely necessary to control insect and disease considerations. Provide minimum canopy of 20% in blocks of ponderosa pine and 35% in blocks of mixed conifer and lodgepole pine.

> Reason: By managing within the range of the natural canopy closure, peak flows would remain closer to reference conditions. This will help to decrease effects of scour on stream banks.

Vegetation

A. Upland (Forested) Vegetation

1. Reduce stand density to a level that falls between the Upper (UMZ) and Lower Mangement Zones (LMZ) for plant associations (Table 54). Higher densities may be necessary in some specific cases to meet wildlife habitat needs identified under Species and Habitats recommendations.

Table 54. SDI (Stand Density Index) Management Zones by Plant Association

Plant Association (Hopkins 1979)	LMZ	UMZ
Ponderosa Pine (PP)		
CPS314, CPS212	108	161
CPH311, CPS215, CPC211, CPS211, CPS112	103	153
CPS311, CPS213	98	146
CPS211, CPS217*	100	150
CPS217	86	128
CPF111	71	106
CPS214	113	168
CPS311	110	164
Pine Associated (CW)		
CWS313 (PP), CWS114 (WF)**	108	161
CWS313 (WF), CWS114 (WF)**	281	370
CWC411 (PP)**	86	128
CWC411 (WF)**	188	281
CWC311 (PP)**	114	170
CWC311 (WF)**	188	281
CWH211 (PP)	191	285
CWS117 (PP), CWS112 (PP)	108	161
CWS115 (PP)	115	172
CWH111 (PP)	120	179
Lodgepole Pine (LP)		
All (CL) plant associations	114	170

* The two different management zones result from this plant association being described in both Hopkins' Plant Associations for the Fremont National Forest and Volland's Plant Associations for the Pumice Zone. They are the same plant association but on different soils and have a different productivity index.

** These are different SDI management zones for ponderosa pine and white fir depending on the dominance of the species within the plant association.

> Reason: These management zones are based on calculations by Cochran (1994) which combine both GBA (Growth Basil Area) and SDI (Stand Density Index) assumptions to determine the upper and lower management regimes within stands to minimize mortality induced by insects and disease. Density managed between these zones increase vigor of the stand and reduces density-related mortality by allowing for growth into unoccupied growing space. Many acres are at risk of substantial change from density-related mortality because they exceed the upper management zone. The high risk is in stands which have a remaining overstory of large diameter trees and a dense understory as well as the evenaged stands that are overstocked. Stands managed between the upper and lower limit have the greatest opportunity to meet management objectives required by various resources and maintain overall stand vigor.

2. Treatment of forest cover should emphasize reduction of multi-storied stands where the stand structure is unstable due to unnatural disturbance regimes and is likely to undergo significant change in the next decade or two (Map 12). These stands are typically lodgepole pine where nine inch trees exceeds thirty per acre and pine associated below 6,000 to 6,500 feet in elevation. These stands should be moved toward a more open condition where canopy cover is in the range of 20 to 35% and basal area is reduced to an average of 80 square feet with a range of 60 to 100 square feet. Higher canopy cover and basal area may be necessary to meet wildlife habitat needs under Species and Habitats recommendations. The risk of maintaining the higher density level must be an integral decision for stand treatment, based on probability of stability, cost of meeting management objectives and species habitat needs.

> Reason: Forest cover is experiencing change at a rapid rate because of an abnormal disturbance pattern. Lodgepole is beyond maturity and the normal replacement cycle. Many of the pine associated stands are too dense and the white fir understory is out competing the large trees. Analysis indicates that a large change in multi-storied stand structure will likely occur within the next drought cycle.

3. Both mechanical harvest and pretreatment of forest cover for reintroduction of fire on a more natural disturbance regime should be emphasized. Management of the large tree component along with felling of small stems and a reduction in fuel bed depth should be used to control the intensity of underburning. Underburning should be emphasized first in pine stands and second in pine associated stands below 6,000 foot elevation.

> Reason: Stands that are overstocked with trees larger than 21 inches and a dense understory will continue to suffer increased mortality even with some removal of competing understory vegetation. These stands should be the highest priority for treatment if the objective is to maintain the large tree component as long as possible. Harvest of overstocked large trees needs to occur even though current direction is to the contrary.

4. Treatment of existing evenaged pine and pine associated stands should favor the development of large diameter ponderosa pine. Replacement of the large tree component in these stands should occur as quickly as possible using commercial thins.

> Reason: Past harvest activity, including timber cut on private land has reduced the amount of large diameter pine trees. The watershed has been entered in many places three times to remove the large tree component which is now below the level needed to meet the desired condition for wildlife values.

5. Vegetation treatments must consider the economic viability of wood product removal both with mechanical harvest and prescribed fire. Market condition will dictate the mix of sales to accomplish density management. An inventory of potential treatments should be developed and stored in an easily retrievable database. The offering of saleable material must be able to respond to quickly changing market conditions.

> Reason: Density management will be accomplished both with mechanical harvest and prescribed fire. Treatments of this type are usually thins that remove smaller, low-valued wood products. Even with a mix of large trees, economics must be part of any treatment prescription if management objectives are to be accomplished. In many cases, material being sold is of marginal value or not in demand. The likelihood of timber removal generating trust fund dollars for other restoration efforts such as wildlife habitat improvements will probably not happen in the Lakeview Sustained Yield Unit. Sales must be offered that will utilize timber harvest to accomplish as much restoration as possible.

6. In areas of declining forest health, utilize thins from below, sanitation salvage and clearcutting to minimize the potential for significant increase in adverse impacts to stand development and growth from mistletoe, insects and disease. Multi-storied stands should be reduced to a more simple stand structure of three layers that will meet most other resource needs. Pine associated and true fir that are entered should have all cut stumps larger than ten inches treated with Borax to reduce the spread of Annosus during harvest. Stumps have to be treated within 24 hours.

Plantations, regeneration units, or old overstory removal units that have scattered remaining large trees should be scheduled to have these trees removed. Many times these trees were left from previous high grade logging and represent the dysgenic selection of the poor end of the gene pool. If these trees are left for other resource values they should be killed standing as soon as possible.

Young and intermediate sized stands of ponderosa pine and pine associated trees should be scheduled for thinning, depending on market conditions, within the next decade to maximize growth and sustain vigor. Stands that are vigorously growing must be cultured to meet the needs for large diameter trees.

> Reason: Mistletoe spread and the potential to incur damage to pine stands is the greatest in single species stands with multilayered canopy. The overall Hawksworth rating needs to be reduced to 1 or 2 in infected stands to minimize the impact of dwarf mistletoe.

7. As prescribed fire is used to move systems to a more natural disturbance regime, burned areas should be evaluated after 10 years to determine the schedule for reburning. Areas scheduled to be burned should be coordinated with resource specialists to determine priorities

for treatment or retreatment (Map 11). They should be evaluated for effectiveness in meeting structure and other resource objectives.

> Reason: By moving toward an inherent fire disturbance regime, the potential for catastrophic loss of resource values may be reduced. Maintenance of vegetation, a reduced fire hazard and restoration of other resource values can be achieved at a lower cost. Regeneration of shrub stands with prescribed fire should lead to a more sustainable situation in the long term but there may be a change of stand structure in the short term.

8. All vegetation treatments will be approved by a certified silviculturist.

> Reason: Forest Service direction requires that vegetation treatments of all kinds be approved by a certified silviculturist. There are many ways at times to accomplish vegetation management objectives. Most certified silviculturists have been trained to formulate alternatives to meet management objectives and can provide expertise in all arenas of vegetation management.

B. Rangeland

1. Begin to implement prescribed fire as a vegetation management tool on the areas identified on Map 11.

> Reason: Restore fire as a natural disturbance agent on a return interval within the historic range of variability or a modified regime where necessary to meet other resource needs.

2. Identify sites, especially big sagebrush and aspen, where juniper control is needed. Develop a juniper management plan for the watershed. Determine the type and extent of control needed based on vegetation objectives for these sites. Recommended methods for juniper control include: cutting, prescribed burning, girdling and mechanical treatments, where appropriate. Establish free use firewood cutting areas in juniper stands. Many factors determine the best method to control juniper. Factors include the amount of understory, topography of the site and size of the juniper. On many sites, junipers have become big and thick enough that prescribed burning alone is not effective. On these sites, it is necessary to consider other methods such as selectively cutting trees.

> Reason: Juniper is invading big sagebrush and aspen, changing the nature and condition of these sites.

C. Noxious Weeds

1. Emphasize prevention of the spread of noxious weeds as the preferred control measure in both timber and range management activities. Preventing the spread of noxious weeds can be achieved through a variety of methods, including: washing of heavy equipment in between projects, regular washing of field vehicles (especially underneath), periodic inspection of material sites to insure weed free material, requiring weed free hay for recreational horses, reseeding disturbed areas with certified weed free seed to prevent invasion.

> Reason: The noxious weed control EA for the Fremont National Forest/Lakeview District BLM is scheduled to be revised in 1998. It will provide specific requirements for control of noxious weed populations.

2. Continue to expand the weed program to treat and/or monitor all known weed populations. The control program needs to expand to include all landowners so weeds can be effectively controlled.

> Reason: Weed populations continue to expand every year and therefore the effort to contain and/or eradicate them must also continue to expand. Through education and outreach employees and the public can be instructed how to identify and report new weed populations.

3. Continue to work with the weed advisory group for Warner Valley to coordinate inventory and treatment programs for maximum effectiveness.

> Reason: The weed advisory group for Warner Valley can improve control through coordination and cooperation, and can also apply for grants and other funds available to groups. A grant would provide the funds to treat an entire population of weeds within the valley instead of the individual treatments being done now.

D. Riparian

1. In riparian areas that are in a state of decline due to forest health problems, conduct stocking level control to reduce the SDI between the upper and lower management zones. This will improve the vigor of the residual stand. Plan, in cooperation with silviculturists and resource specialists, those activities that will restore the riparian zone to meet resource objectives. Treatments that remove logs should be restricted with the objective of minimizing soil disturbance. This will require low impact ground based systems or advanced systems such as low ground pressure skidding equipment with one end suspension, cable systems with suspension, aerial systems or winter logging on frozen ground. Treatments within riparian zones that require advanced systems will have to be economically sound to accomplish any restoration objectives.

> Reason: Riparian zones that do not meet resource objectives will require restoration treatments. Logging in these zones to accomplish the objectives will require a minimum of soil disturbance to reduce soil erosion potential and subsequent sediment in stream systems.

2. Manage for more acres of aspen and cottonwood habitat than presently exist on the landscape to help move the diversity and distribution of woody deciduous plant communities toward the historic range of variability (Map 12). Aspen and cottonwood should be managed to provide a variety of seral conditions from early to late. This will require a continuing inventory and long-term silvicultural treatment plan to accomplish resource objectives.

Manage pure aspen stands to maintain the dominance of aspen stems in both the mature and earlier seral stages. At least one-third of the existing mature stands will be converted to a younger age class and managed as replacement stands. Mature stands in poor condition will receive priority for treatment. Manage mixed aspen stands to maintain the present basal area ratio of aspen in the stand. Mixed stands of aspen in the poorest condition will have highest priority for treatment.

Aspen stands that are in a state of decline due to conifer encroachment, lack of regeneration or grazing pressure require treatment to restore the aspen component. Removal of conifers, establishment of reproduction through coppice sprouting and control of grazing should be utilized to improve the clones. Stand disturbance to stimulate reproduction can be accomplished by mechanical methods such as felling and yarding, prescribed fire or a combination of both. Slash treatment and logging systems must be a prime consideration when merchantable conifers are removed from aspen clones. Aspen treatments must be planned in an interdisciplinary team process considering all resource values.

Clones that are no longer able to regenerate vegetatively will require silvicultural treatments and site preparation to provide adequate site conditions for planting aspen and cottonwood cuttings. If possible, cuttings should be obtained from the parent clone. Follow the requirements of the Fremont National Forest Native Species Guide for utilizing material from existing clones.

Fencing will be required to protect aspen and cottonwood sprouts or cuttings from livestock and big game use. Exclusion of livestock should occur until the sprouts are over six feet tall. In elk areas, exclusion should continue until sprouts are over 12 feet tall.

> Reason: In general, aspen and cottonwood stands are in decline. Additional aspen will help meet the habitat needs and possibly improve the population performance of associated wildlife species. Aspen stands are generally our most diverse plant communities in terms of both plant and animal species composition and productivity.

E. Sensitive Plant Species

1. Follow standards and guidelines set forth in the Forest plan and individual species' conservation strategies for management of threatened, endangered and sensitive plant species.

> Reason: Management direction.

F. Cultural Plants

1. Continue consultation with Native Americans to insure their traditional collecting can continue.

> Reason: Consultation is necessary to protect these sites and build better relationships with Native Americans.

2. Protect native food plants used by the Northern Paiute peoples. Increased vehicle and human activity could be causing soil erosion and noxious weed infestation problems. There could be a need for future road closures and increased weed control.

Water Quality

A. Implement items in Element 3 of the Water Quality Management Plan (WQMP) for the Deep Creek watershed on National Forest System lands. The following eight recommendations only apply to the USDA Forest Service per the WQMP.

1. Implement the grazing terms and conditions of the USFWS biological opinion for the Deep Creek watershed.

2. Pursue cooperative programs with adjacent landowners to reduce stream temperature and erosion/sediment transport resulting from historic and current land management practices.

3. Manage riparian vegetation to restore or maintain structure, age and composition consistent with site potential. The goal is recovery of stream temperatures by increasing shading from vegetation and narrowing the stream channel morphology.

Riparian vegetation objectives should be measured by similarity of current riparian vegetation to the potential late ecological status riparian community/composition. The objective is to have at least 60% of the green line community types in the late ecological status (consistent with the riparian vegetation RMO for Alternatives 4 and 6 of the ICBEMP, 1997). The tool that will be used to determine the percent of the species within this ecological status is the Riparian Ecosystem Classification Project for the Fremont National Forest (due for completion in 1998).

4. Utilize Best Management Practices (BMPs) for grazing and roads identified in the biological opinion.

5. Develop and utilize BMPs for timber and fire management.

6. Emphasize decompacting soil in logged timber units. Also, hydrologically decomission roads to desyncronize effects of peak runoff.

7. Emphasize planting willows and cottonwood to provide shade where appropriate.

8. Emphasize implementation of recommendations in the watershed analysis to help achieve water quality restoration objectives of the WQMP. These are identified by indicating that they apply to Element 3 of the WQMP.

B. Other Water Quality Recommendations

1. Consider changing grazing systems and combining allotments to improve livestock distribution and timing of grazing. This could be achieved by combining allotments to take advantage of a larger land base. (Applies to Element 3 of WQMP)

> Reason: Livestock grazing has impacted riparian areas throughout the watershed. Present deferred and deferred rotation systems are rated as poor to fair for riparian resources (Platts 1991). Switching to a system that is more favorable to riparian systems (i.e. rest rotation) may help to improve riparian conditions including shading and bank stability.

2. Partnerships (Applies to Element 3 of WQMP)

Develop partnerships with private landowners to improve stream/riparian conditions. Place particular emphasis on providing habitat conditions to meet the State water quality stream temperature standard of 17.8ºC mean 7-day maximum temperature. Continue with existing working agreements.

> Reason: Improving stream temperatures through these areas will help achieve habitat objectives throughout the entire stream length.

3. Best Management Practices (BMPs) (Applies to Element 3 of WQMP)

Apply site-specific BMPs to activities with the potential to affect soil productivity and water quality and quantity. Emphasis should be given to Pacific Northwest Region BMPs and use of site-specific BMPs.

Reason: BMPs will help to meet water quality objectives.

4. Public Water Supply

Identify the drainage area above the potable water collection area for the Town of Lakeview and create a management plan for the area. Emphasize meeting the terms of the Safe Drinking Water Act for municipal water supply.

Reason: This will provide a positive step towards ensuring a long term source of drinking water for the Town of Lakeview.

Aquatic Resources/Stream Channel

A. Large Woody Debris (LWD)

Large woody debris (LWD) in forested reaches should be restored to historic levels shown in Table 41. Achieve at least the 50th percentile. Work with silviculture to develop unevenaged stands within RHCAs for all streams where historic cutting has occurred or where forest health is of concern.

Reason: Large wood has been identified as lacking in some streams. Providing large wood to the channel will enhance sediment retention of tributary streams and help to improve water quality in fish-bearing streams.

B. Channel Morphology (Applies to Element 3 of WQMP)

1. Restore streams to the desired natural channel morphology. Rosgen stream channel types G and F should be moved toward channel types C and E, as appropriate. Rosgen parameters for width to depth ratios and sinuosity should be used as target objectives.

2. Reduce bank erosion levels to less than 20% on all C and E channels and less than 10% on all A and B channels.

3. Improve site conditions for meadow riparian vegetation by raising water table levels through stream channel restoration. Raise water tables in alluvial depositional areas.

Reason: Degraded G and F type channels are typical in alluvial depositional and some meadow areas. Restoration will decrease sediment and improve base flow.

C. Pool Habitat

Implement habitat management and restoration treatments that help achieve at least the 50th percentile for pool frequency and deep pools.

Reason: The number of pools per mile can be increased by lowering sediment input to the stream channel, improving quantities of large wood, improving stream channel morphology and by physically constructing pools through habitat improvement projects. Improving pools per mile and pool depth will result in improved fisheries habitat.

D. Floodplain Restoration (Applies to Element 3 of WQMP)

Improve beaver habitat along both perennial and intermittent streams to enhance floodplain restoration. Encourage willow, aspen and cottonwood development within the floodplain. Methods may include constructing grade control structures to raise the water table, planting willow wattles along reaches of the stream channel and encouraging regrowth of willow through grazing management.

Reason: Enhancement of beaver habitat will allow beaver to establish in marginal habitat areas and help in floodplain restoration. Benefits of beaver ponds include a raised water table, increased summer flow, sediment trapping behind beaver dams, refugia for native fish and improved wildlife habitat.

E. Riparian Habitat Conservation Areas (RHCAs)

RHCAs are portions of watersheds where riparian-dependent resources receive primary emphasis and management activities are subject to specific standards and guidelines. These areas should be managed to meet interim riparian management objectives as identified in the Inland Native Fish Strategy (INFISH) or the Interior Columbia Basin Ecosystem Management Project (ICBEMP) when it replaces INFISH. Timber, roads, grazing, recreation, minerals, fire/fuels, lands and general riparian management areas are addressed in INFISH.

Examples of allowable management activities in RHCAs are burning to provide enhanced diversity of vegetation, felling of trees to provide a diverse age structure and limited end-lining of some trees from the exterior of RHCAs. Skidding, landings or machine piling of slash should not be permitted along lengths of intermittent or perennial streams. Activities within these areas should be reviewed by the watershed specialist. Recommended RHCAs are shown in Table 55:

Table 55. Recommended RHCAs

	Total Width (Both Sides)	
Type of Aquatic Ecosystem	RHCA (ft)	Stream (ft)
Perennial Fish-Bearing Streams	300	600
Perennial Nonfish-Bearing Streams	150	300
Intermittent Fish-Bearing Streams	300	600
Intermittent Nonfish-Bearing Streams	50	100
Springs, Marshes, Lakes, Meadows greater than 1 acre in size	150	300
Springs, Marshes, Lakes, Meadows less than 1 acre in size	50	100

Perennial Stream. Normally flows year long, except during periods of extreme drought. Has well-defined channel and show signs of washing and scouring.

Intermittent Stream. Carries water most of the year, but ceases to flow during the dry season because evaporation and percolation into its bed and banks exceeds the available stream flow. Has well-defined channel showing scouring or washing.

Reason: RHCAs provide the managed habitat for riparian-dependent resources. Soil, water and fisheries benefit from buffer widths that provide sediment filtering from upland management. Vegetation management provides shade and a long-term source of large wood to the stream channel.

F. Fisheries

Review existing culverts that are fish barriers to determine if they should remain or be removed.

Reason: Fish barriers may block redband trout movements in some of the headwater streams.

H. Restoration and Improvement Projects

Implement projects identified on Map 9 from the Watershed Improvement Needs Inventory (WIN):

1. Control erosion and stabilize 1.4 miles of Camas Creek managed by the Forest Service through use of large wood, boulders and willow plantings.

2. Armor headcuts and install checkdams in Willow Creek to control downcutting and restore the function of the floodplain.

3. Reanchor and possibly add more juniper to the banks of Dismal Creek to help prevent bank erosion.

4. Introduce large wood to Mud Creek, through the use of explosives, to improve habitat. (This is a KV project.)

5. Subsoil Cove Timber Sale.

Species and Habitats

A. Terrestrial

1. Threatened, Endangered, and Sensitive Species

a) Northern Bald Eagle (Threatened)

If bald eagle nest or roost sites are identified in the future develop a Bald Eagle Management Area (BEMA) plan to protect or enhance this habitat. Use prescribed burning, mechanical treatments, road management and prey base enhancement to meet the objectives to restore or enhance bald eagle habitat.

Reason: Prescribed underburning and/or mechanical treatment would be used to reduce stand densities, fuel loads, white fir competition and maintain ponderosa pine nest/roost stand and tree characteristics. Prescribed underburning would also reduce the risk of catastrophic stand-replacing crown fires.

Road closures or activity restrictions would improve habitat security for nesting and roosting eagles within the BEMA and increase the probability of successful fledgling production.

Enhancing habitats to increase prey base populations, particularly waterfowl, fish and deer, would increase prey availability and improve eagle survival and productivity.

b) American Peregrine Falcon (Endangered)

If peregrine nesting activities are identified on Fish Creek Rim or on National Forest System land, initiate a peregrine falcon management plan to protect or enhance nesting, foraging and security habitat. Utilize prescribed burning, road closures and activity restrictions to maintain/enhance habitat.

Temporary or permanent road closures and other activity restrictions would be used to maintain solitude within one mile of active nest sites during the courtship, nesting and fledging period from 2/1 through 8/15.

Reason: Prescribed burning would be used to enhance peregrine hunting opportunities above the rim by improving small mammal and terrestrial ground nesting bird habitat. Management activities and public access may be impacting nesting peregrines if an active nest exists at one of these sites.

c) Western Sage Grouse

Sage grouse habitat should be enhanced through Section 7 compliance on livestock grazing activities for Warner suckers and could be accelerated through the use of prescribed fire and spring and reservoir livestock exclusion (fence and pipe water to outside troughs). Design prescribed fires to minimize loss to winter and security cover (leaving a mosaic of burned and unburned islands of sagebrush) and establish a variety of sagebrush seral stages to meet the entire life cycle needs of grouse.

Reason: To improve sage grouse nesting and brood rearing habitat by providing dense nesting cover and releasing forbs for grouse brood availability to increase grouse productivity.

d) California Bighorn Sheep

Use prescribed burning (Map 11) and current livestock management to enhance California bighorn sheep habitat. If crucial lambing areas are detected and disturbance is causing reduced lambing success, further activity restrictions (Fish Creek Rim is already covered by interim management of wilderness study areas) may be needed to provide additional solitude to the nursery.

Reason: Native perennial bunchgrass, such as bluebunch wheatgrass, will benefit from periodic prescribed fires and shrub succession will also be set back, both desirable conditions for bighorn sheep. Reduced disturbance around lambing areas may increase lamb survival.

2. Keystone Species

a) Big Game

1) Manage forage, cover and road densities on deer and elk ranges to provide habitat conditions necessary to meet ODFW's herd management objectives over the long term.

2) Security habitat

Design forest-thinning treatments to provide a variety of spacing conditions, including no 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 two to 26 acres in size.

A reduction in hiding cover may exist for deer and elk with the loss of shrubs from prescribed burning, however, burning would be carefully planned to minimize these effects. Prescribed burning will provide early successional plant communities beneficial to foraging deer, elk and pronghorn and by design retain interspersed patches of late seral sagebrush/bitterbrush for security cover.

Activity restrictions may need to be addressed in the future as more wintering and fawning/calving/kidding areas are identified. These restrictions will be in coordination with ODFW biologists and may be in the form of a winter cooperative road closure from 11/1 through 4/30 or restricted use from 5/1 through 7/1 to minimize disturbance in deer, elk or pronghorn parturition areas.

3) Edge Habitat

Maintain the quantity and quality of edge habitat. Utilize prescribed fire and selective thinning to maintain or enhance edge habitat. In existing small burns and regeneration harvest units (<80 acres), maintain one to 25 acre forage patches on sites near the edges of units. In more extensive burn areas, maintain one to 40 acre forage patches in a mosaic. Priority areas for treatment include those sites where browse forage species are decadent (especially bitterbrush and mountain mahogany), forage productivity has declined because of an increase in forest cover (including juniper expansion), 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.

4) Forage Habitat

Reduce thinning slash and stem density in areas where herbaceous and woody understory forage plant growth is limited. Place an emphasis on hand piling or burning treatments, but restrict mechanical methods in order to meet soil objectives.

Consider forage seeding obliterated roads, skid trails and landings to increase the forage base.

Utilize prescribed fire (Map 11) to increase the quantity, quality and species diversity of foraging habitat. The potential exists for short-term declines in mule deer populations as habitat is treated with prescribed fire. These treatments may temporarily reduce bitterbrush and sagebrush densities over the short term, but will improve shrub age class diversity, plant density, vigor and productivity over the long term. Prescribed burning will also improve elk forage as well as early spring green-up of grass and forb production for mule deer.

Bitterbrush and mountain mahogany retention areas will be identified in the burn plan in coordination with USFS, BLM and ODFW biologists. Burn areas will be chosen where native grass/forb/shrub seed source is adequate and exhibits the best chance for bitterbrush and mountain mahogany reestablishment/rejuvenation. Prescribed burns will be monitored 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.

b) Beaver

Maintain and restore beaver habitat, both deciduous and herbaceous forage species and water availability near active and historic dam sites where these factors may be limiting recolonization or productivity.

Raise the water table in riparian areas where channel downcutting has occurred.

Continue Section 7 compliance-driven livestock management and/or control livestock stocking rates, season of use, grazing systems and access to critical riparian areas to restore forage species and water availability near active and historic dam sites and along stream reaches of potential habitat.

Implement a multi-year beaver transplant program in areas of potential and/or formerly occupied habitat where riparian vegetation recovery and water levels are adequate to provide at least marginal resources for survival. Multiple transplants over several years at a single site may be necessary until beaver successfully restore habitat conditions to suitable year-round occupancy.

> Reason: Restoration of beaver habitat will increase the area of wetland habitats and associated plant and animal diversity and productivity, improve water and sediment storage and transport and nutrient cycling and decomposition.

c) Nongame Species

Maintain shrub-steppe species habitat through the introduction of prescribed fire (Map 11) with a return interval designed to provide shrub habitat in a variety of seral classes beneficial to associated animals. Continue current livestock grazing management to build up fine fuels necessary to carry a fire and protect seedling establishment. Use prescribed fire and selective cutting in aspen stands and areas of juniper invasion.

> Reason: Maintain or enhance habitat for species dependent on shrub-steppe or riparian habitat types.

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

a) Late/Old Seral Forest Habitat

1) Manage for a late/old seral forest habitat closer to the natural range of historic variability at the subshed level if feasible.

2) Manage for increased patch sizes of interior LOS habitat.

3) Manage for a diversity of stand densities (basal area, trees/acre, dbh) both within and among stands to provide diverse habitat conditions.

4) Manage for an old-growth restoration zone (600-1,200 feet) surrounding presently dedicated and "other" old growth (Map 13) where feasible to buffer and increase forest interior habitat to a level closer to the range of historic variability. Design and implement prescriptions to develop and maintain late/old seral forest characteristics within the zone. Manage forest habitat so that at least 25% of the total recommended LOS forest provides interior "core" habitat. Core area patch size should average at least 225 acres. The minimum size of one or more core areas should be determined (refer to Data Gaps).

5) Manage for larger additional or replacement old-growth stands within 1.5 miles of existing dedicated and "other" 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. Some of the most stable and suitable lands occur around riparian areas, on north and east aspects, and at higher elevations.

6) Implement non-uniform thinning (Map 12) and prescribed burn (Map 11) treatments where possible to control understory stocking levels, reduce fuels, develop multi-storied stands, restore open park like ponderosa pine stands where appropriate, and culture the development of large diameter live trees and future snags and logs.

7) Establish Interim Riparian Habitat Conservation Areas and manage forest stands within these areas to conserve LOS forest as a network of corridor habitat (Map 13). Again, implement non-uniform thinning and prescribed fire treatments where necessary to control understory stocking, reduce fuels, develop canopy gaps, restore open park like ponderosa pine stands where appropriate, and culture the development of large diameter live trees and future snags. When appropriate within this LOS forest corridor, implement small patch regeneration treatments to restore stands of shade intolerant deciduous species such as alder, willow, aspen and dogwood.

8) Manage all "other" late/old seral habitat mapped in the inventory completed in 1994 to conserve its character as interior and corridor habitat.

9) 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 simply 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(es) or strip(s) is progressively enlarged by continuous cutting.

10) Maintain or restore connectivity between all remaining other LOS stands and dedicated stands (Map 13). Specific desired conditions for connective habitat are described in the

"Forest Plan Amendment for Interim Standards" under "Interim Wildlife Standards" in the Forest plan.

11) Maintain or restore the abundance and distribution of large diameter snags, large diameter live LOS trees and large down logs in all forest 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.

12) Manage for a higher basal area of large diameter white fir (>15" dbh) in true mixed conifer plant associations above 6,500 feet elevation in general, and down to 6,000 feet elevation on some north and east aspects. Priority areas would be occupied and historic pileated woodpecker foraging and nesting sites, and occupied or suspected marten habitat. Canopy closures in forest stands where foraging is evident should be managed at >60%. Manage to maintain >five trees per acre that are > 20" dbh.

13) Maintain or restore open park like stands of LOS ponderosa pine with average tree diameters >20" dbh (10 to 40 trees/acre) for white-headed and Lewis woodpeckers and pygmy nuthatch. A desirable condition would be trees >2" dbh comprising >40% of the total basal area at a density of >eight trees/acre. Implement mechanical and prescribed burn treatments to reduce stand densities. Thin overstocked understories, reduce accumulated duff, and culture patches of non-uniform multi-storied pine understories and large diameter live trees and future snags.

> Reason: The goal is to develop a late/old seral forest network that protects and enhances the habitat effectiveness of the remaining late seral forest ecosystem to sustain associated MI wildlife species by restoring historic characteristic landscape scale features. Conservation of late/old seral forest habitat representation rather than preservation of individual patches is the objective. A proposed late seral patch and linkage system is shown on Map 13. A review of stand conditions to determine their suitability as late seral patches should be conducted.

b) Goshawk

1) Manage to protect active and historic nest stands and treat replacement stands and PFAs to develop and/or restore preferred habitat conditions for goshawk nesting and rearing, and to provide prey species habitat needs.

2) 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 historic nest areas from timber harvest.

3) Replacement nest stands needing improvement should be treated with thinning from below (variable or non-uniform spacing) using either mechanical means or prescribed fire to promote faster tree growth and crown development, open the understory and reduce risk to insect, disease and stand-replacement fire. Lop and scatter slash that cannot be burned. On the forest, every documented nest site is considered "historically active" whether or not it has been monitored for activity in the past five years. Suitable habitat as defined in the Forest plan must be present at the nest site.

4) Designate a 400 acre "Post-fledging family area" (PFA) consisting of the most suitable habitat around every known active nest site. Manage to maintain or restore the late/old seral structural characteristics of forested stands within at least 60% of the PFA. Maintain a minimum canopy cover of 50% in ponderosa pine and 60% in pine associated and lodgepole pine. Create scattered openings two acres or less where necessary. Leave three to six large diameter reserve trees per acre in clumps in the openings. Use either mechanical treatments and/or prescribed fire to treat dense understories, promote large tree growth, crown development, understory herb and shrub development, and more open stand conditions for hunting and prey availability. Thin to non-uniform spacing. Lop and scatter slash that cannot be burned.

5) Maintain solitude in the active nest areas and PFAs during the breeding, nesting and fledging period (March 1 - September 30), or during period of occupancy as determined from field observations, to improve the probability of successful fledgling production.

6) Retain five to seven and 10-15 tons/acre of woody debris, greater than 3" diameter in ponderosa pine and pine associated forest types, respectively, to provide habitat for prey species within territories.

Reason: The northern goshawk is listed as a Species of Concern by the U.S. Fish and Wildlife Service. Minimizing disturbance and maximizing habitat potential will aid in preventing further reductions in population numbers, as well as a trend toward federal listing.

4. Dead Wood Habitat Management Indicator Species

a) General

1) In all stands of ponderosa pine and pine associated forest, design future timber harvest treatments to maintain or restore snags and green tree 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 conditions for snags and down logs are described in the "Forest Plan Amendment for Interim Management Direction Establishing Wildlife Standards for Timber Sales" in the Forest plan.

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:

The following is the standard for "...snag and green tree replacements of greater than or equal to 15" dbh at 100% potential population levels for primary cavity excavators". One clarification is that this is not 100% of population potential as defined by the Forest plan.

DBH	Height	Trees/Acre
Pine Associated		
15"+ (20" preferred)	20'+	3 dead + 2 green
10"+ (12" preferred)	20'+	1 dead + 3 green

DBH	Height	Trees/Acre
Lodgepole Pine		
12"+	15'+	1 dead + 1 green
10"+	15'+	1 dead + 1 green

2) Manage snags and GTRs in dispersed clumps rather than individual trees uniformly scattered over the landscape. As a minimum, manage for one clump per five acres consisting of both dead and green replacement trees. This is based on the smallest home range size of primary cavity excavator species in the current literature. Manage snags and GTRs in the same species composition as representative of the stand.

3) Manage for a large proportion (>50%) of standing snags >33 feet in height. Retain spike-topped and lightning-scarred trees that provide alternate nesting substrates.

4) In snag deficient areas, where feasible and appropriate, create snags from live trees and/or manage adjacent forest stands for higher densities to partially compensate for the deficient areas. Implement top-blasting, girdling and/or injection to create snags, with girdling being the least preferred method.

5) Culture GTRs in early and mid-seral stands to develop future large diameter snags at the desired species composition and densities for the full stand rotation.

6) Protect down logs and snags with fuel breaks and/or burn prescriptions where necessary to maintain the desired densities and size classes when implementing prescribed burn treatments.

7) Stands identified for snag retention will be entered into a GIS database to develop a permanent record of size, species composition and location.

> 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 most LOS structural forests. Past management practices have greatly reduced the number and availability of snags and down logs in managed stands.

Human Uses

A. Human uses should continue to focus around outdoor recreation activities such as camping, firewood gathering, fishing, hunting, hiking, horseback riding, off-highway vehicle (OHV) riding, mountain bike riding, cabin renting, snowmobiling and cross-country skiing.

Recreation activities involve camping at developed and dispersed campgrounds (forest camps), hiking on trails in the high country around Crane Mountain, seasonal hunting and fishing. The needs of campers at the developed sites should be adhered to while at the same time giving the forest user as much of a primitive recreation experience as possible.

B. Road closures and roadless areas will enhance the outdoor experience of dispersed forest users that are hiking and camping in the back country by giving them more of a feeling of being alone in a semiprimitive wooded environment.

C. Opportunities in the developed campgrounds need to be expanded to ready for the increased use of the next few decades. The concepts of accessibility need to be applied to these developed areas.

D. Improve habitats for deer and elk to increase hunting opportunities for these species in the future.

E. The trail system that is now in place fills present day needs. However, a look to the future might show a need for an expanded system that would go out of the campgrounds into the major trail system that goes along the spine of the Warners.

F. Signing and interpretive activities would add to the experience of the forest user.

G. The numerous sensitive archaeological sites need to be protected and used for ongoing scientific research.

H. OHV development in the area should be looked at and surveyed for future possible use.

I. Range

1. Swift response and proper fence maintenance by the agencies and permittees should continue where cattle are detected in protected riparian exclosures and pastures.

> Reason: To ensure riparian exclosures and pastures receive proper rest and do not incur any significant grazing.

2. Allotment evaluations need to continue and be done in a systematic manner to insure that grazing management is meeting objectives.

> Reason: Allotment evaluation is a formal document that insures that data being collected is summarized and analyzed. This analysis insures the allotment management plan is being followed and that it is the proper management for the resources. This process provides an opportunity to evaluate impacts on resources and make changes in management when appropriate.

3. Every opportunity to better coordinate private and public land management should be explored and utilized. This would include grazing associations, weed boards and watershed councils.

> Reason: Private and public lands are often intermingled and impacts from activities can not be separated. Therefore, any opportunity to coordinate management should be explored.

4. Incorporate juniper control and prescribed burn plans into allotment management plans (AMP) whenever possible.

> Reason: Incorporating prescribed burns and juniper control into AMPs would promote implementation and better post treatment management of the treatment area.

□

Monitoring Needs

A. Vegetation

1. Utilization pattern mapping is being done every year on the grazed areas and trend transects with photos are being read every five years. There will continue to be periodic evaluations of monitoring data to determine trend of the allotment.

2. Better coordinate and expand our riparian monitoring to include quantifiable vegetation data. Establishing permanent vegetation transects in riparian areas would document changes in riparian vegetation over time. Recent changes in management have resulted in changes in vegetation and it is important to document these changes.

3. Establish both research studies and vegetation monitoring on prescribed burn sites to document changes in vegetation over time and determine short- and long-term impacts of burning on different sites. These studies would document benefits and impacts of burns and help determine what burns should be done in the future.

4. Establish both research studies and vegetation monitoring in juniper control projects to document changes in the sites, determine if objectives are being met and to document how effective the control is over the long term. Research is also necessary to determine which areas should be controlled in the future and which techniques are the most effective. Vegetation monitoring studies will help evaluate short-term impacts and determine which management strategies should be used in the future.

5. Continue annual range utilization mapping and trend studies to determine condition and trend of vegetation. Expand these studies as much as feasible. This monitoring is critical to evaluate the annual impact of grazing on vegetation and other resources to determine if grazing management is meeting objectives of the allotment management and annual operating plans. These studies are also used to determine long-term vegetation trends under different management strategies.

6. Do some spot checks on the Ecological Site Condition Inventory (ESI) transects to determine if there is any change in ecological condition ratings over the last 10 years. The reason for spot checks (sampling) is the large number of ESI transects in the area.

7. Continue to inventory threatened and endangered plants for new populations and monitor existing populations of sensitive plants. Existing populations need to be monitored to insure current management is properly protecting these plants. Monitoring could also identify other factors that might be impacting these populations. Inventory for new populations can help protect these populations or can result in plants being removed from the list.

8. Continue airplane compliance and ground checks of riparian areas to insure exclosures and riparian pastures receive proper rest. Airplane compliance checks of riparian areas once a week is a fast and efficient way to determine if cattle are in the wrong location. Compliance checks combined with quick ground checks have detected cattle in protected riparian areas before they have done any significant grazing.

□

B. Water Quality

Implement monitoring items in Element 3 of the Water Quality Management Plan (WQMP) for the Deep Creek watershed on National Forest System lands.

1. Use monitoring to determine the ecological status and potential natural vegetation of key areas in each pasture.

2. Complete monitoring reports to the USFWS by February 1 each year as outlined in the biological opinion.

3. Complete long-term effectiveness monitoring as outlined in the biological opinion.

4. Complete effectiveness monitoring reports to the USFWS during the life of the consultation. These include:

a) A report addressing the relationship between stubble height and utilization and incidence of use on willows by March 1, 1999, and

b) Results from effectiveness monitoring sites by 2001 and again in 2007 .

C. Aquatic Resources/Stream Channel

1. Establish reaches for monitoring redd counts for redband trout. Reaches and redd counts are being conducted across the forest in conjunction with U.S. Fish and Wildlife Service requirements.

D. Human Uses

1. Monitor archaeological site integrity.

2. The effects of cattle and fire on cultural plants need to be monitored.

Data Gaps

A. Vegetation

Stand inventory of species, volume and numbers.

Site-specific inventory of aspen and cottonwood groves including location and condition.

Timber removal and logging plan for the forested portion of the watershed.

Further definition of the historic or stable LOS vegetation pattern, i.e. "How much was there?"

Further definition of the inherent fire disturbance regime.

Continued investigation of the pine associated community type to determine stand characteristics associated with a frequent fire regime.

Inventory noxious weed sites.

B. Aquatic Resources/Stream Channel

Perform a genetic study of redband trout in tributary streams. The study should be conducted to determine the level of introgression that has occurred within the watershed. Stocked rainbow trout have potentially introgressed with native redband trout. Maintenance of native fish meets requirements of the Federal Land Management Policy Act (FLMPA) and National Forest Management Act (NFMA) for maintaining resource values of aquatic species. Knowledge of genetically pure fish populations could help in planning of future projects.

Initiate population inventory (census) for redband trout. This species has been petitioned for listing. The data is inadequate to determine the status of this species and a population estimate would help establish the need for legal protection. This inventory would complement the data gap on genetic determinations.

C. Wildlife

Current beaver colony locations.

Sage grouse use of forested lands.

Structural stage acres by vegetation type by subshed under current conditions.

Goshawk locations and condition of home ranges.

Acres and condition of LOS aspen.

Current snag and down log numbers and distribution.

TEAM MEMBERS

The list below includes the core and support team members of the interdisciplinary team who were responsible for the preparation of this document.

NAME	TITLE	EDUCATION AND EXPERIENCE
Core Team Members, Fremont National Forest		
Terry Hershey	Forest Wildlife Biologist	BS-Wildlife Biology, MS-Wildlife Management, 18 Years
John Kaiser	Forest Archaeologist	BA-Anthropology, 18 Years
Doug Middlebrook	Wildlife Biologist	BS-Wildlife Sciences, 9 Years
Mike Montgomery	Forest Hydrologist	BS-Civil Engineer, 14 Years
Bob Petersen	Silviculturist	BS-Forest Management, MS-Forest Ecology, 28 Years
Janine Cannon	Environmental Coordinator	BS-Political Science, 28 Years
Dennis Griffin	GIS Specialist	BS-Forest Management, 22 Years
Core Team Members, Lakeview Resource Area, Bureau of Land Management		
Les Boothe	Range Management Specialist	BS-Range Management, MS-Range Science, 16 Years
Alan Munhall	Fisheries Biologist	BS-Range Management, BS-Wildlife Management, 23 Years
Vern Stoffleth	Wildlife Biologist	BS-Wildlife Management, 15 Years
Paul Whitman	Planning, Environmental, and GIS Coordinator	BA-Biology, MS-Zoology, 13 Years
Support Team Members, Lakeview Resource Area, Bureau of Land Management		
Bill Cannon	Archaeologist	BS-Anthropology, MA-Anthropology/Archaeology, 28 Years
Lucile Housley	Botanist	BA-Botany, MS-Botany, 45 Years
Trish Lindaman	Recreation Planner	BS-Recreation Education, 13 Years

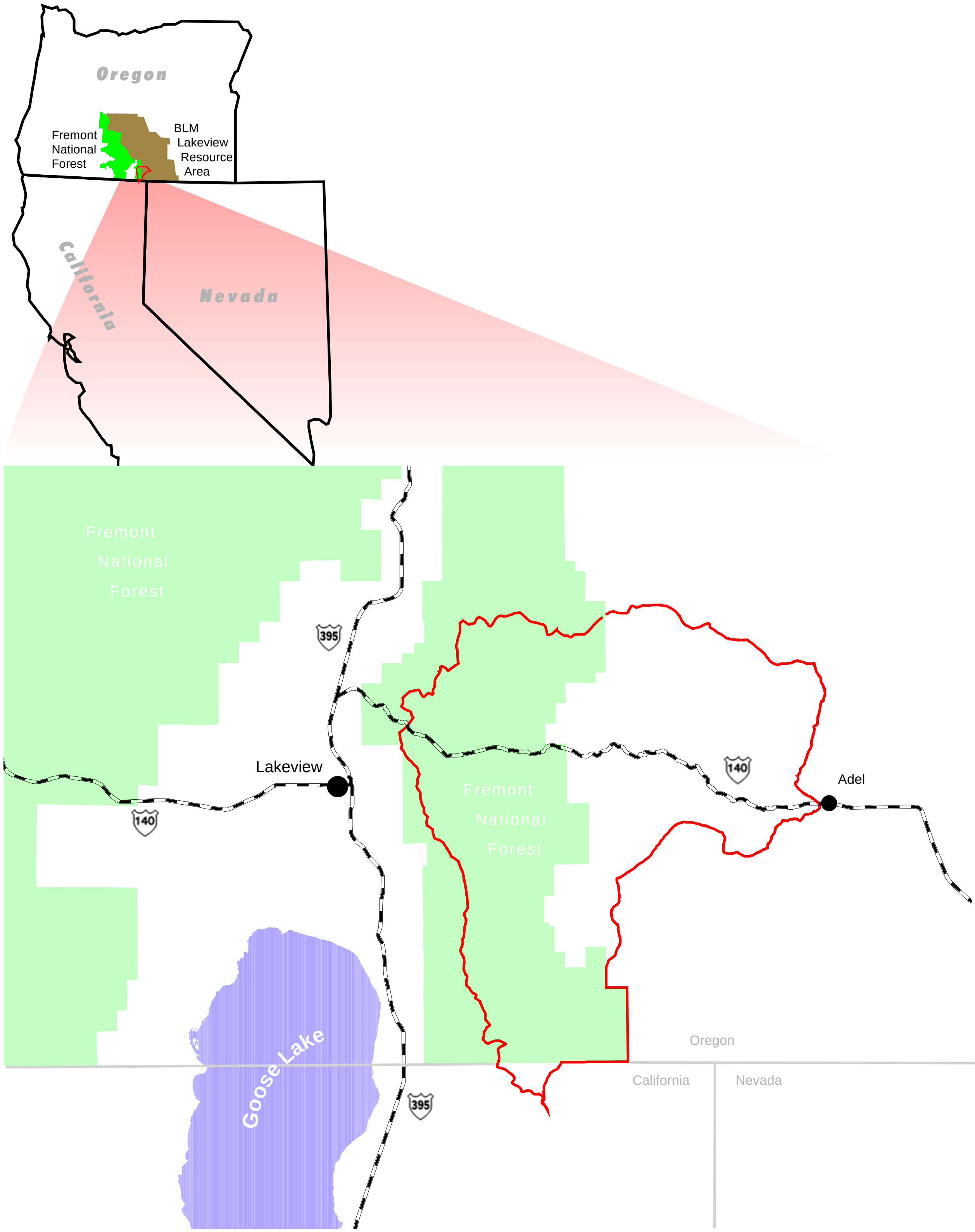
Stream/ Elevation (feet)	Habitat Type	Density by Species (Fish/m²)			
		Rainbow Trout	Redband Trout	Brook Trout	Speckled Dace
Dismal 5760	cascade/boulders		0.01		
5960	cascade/boulders		0.01		
	rapid/boulders		0.02		
	pool-backwater		0.03		
	pool-lateral scour		0.03		
	riffle				
6260	rapid/boulders		0.04		
	cascade/boulders		0.03		
	riffle		0.02		
	pool-lateral scour		0.12		
6880	pool-lateral scour		0.02		
	riffle		0.01		
	glide-pool		0.02		
	glide-riffle		0.01		
6940	glide-pool		0.02		
	glide-riffle		0.01		
	cascade/boulders		0.04		
	riffle		0.02		
Mosquito Creek					
6260	pool-lateral scour		**		
	riffle		0.01		
	pool-dammed		**		
	glide riffle		0.01		
6360	glide riffle		0.06		
	riffle		0.01		
	pool-dammed		0.02		
6700	cascade/boulders		0.09		
7040	glide riffle				

Stream/ Elevation (feet)	Habitat Type	Density by Species (Fish/m²)			
		Rainbow Trout	Redband Trout	Brook Trout	Speckled Dace
Mud Creek					
5510	glide pool				0.03
5540	pool-lateral scour				
	riffle		0.24		
	cascade/boulders		0.02		
5800	pool-straight scour		0.03		
	cascade/boulders				
	riffle w/ pockets		**		
6100	glide pool				
	riffle		0.04		
	riffle w/ pockets		0.03	0.01	
6400	glide pool		0.01	0.01	
	pool-isolated		0.12		
	glide riffle		0.03		
6460	pool-isolated				0.04
Willow Creek					
5650	cascade/boulders		0.03		
	riffle		0.07		
	pool-lateral scour		0.02		0.02
5730	cascade/boulders		0.05		
	pool-dammed		0.01		
5910	glide riffle		0.03		
6030	riffle w/ pockets		0.09		
6040	pool-beaver dam				
6050	pool-lateral scour		0.01		
	riffle				0.03
	glide pool		**		0.09

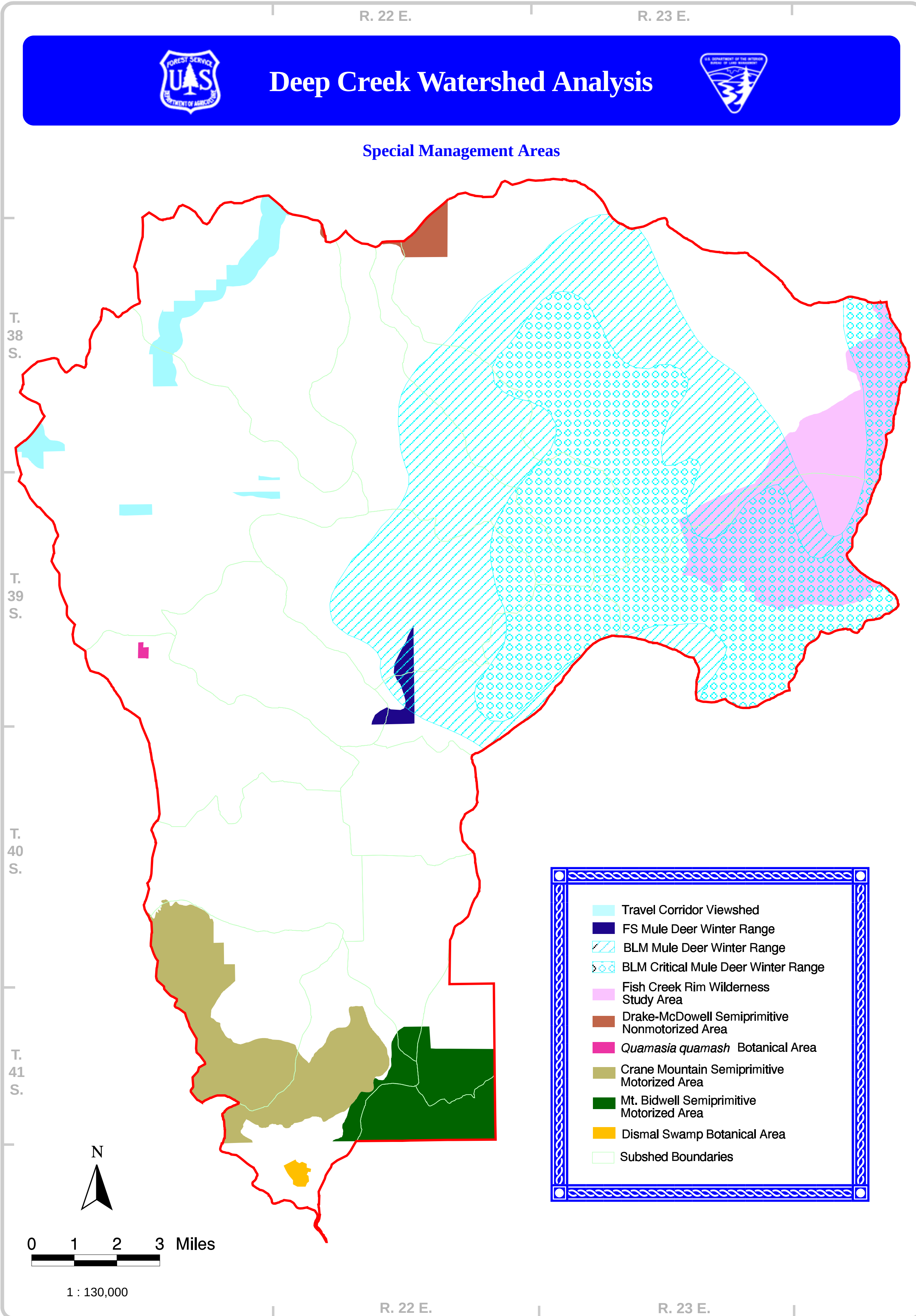
** Fish present but less than .01 fish/meter²

Deep Creek Watershed Analysis

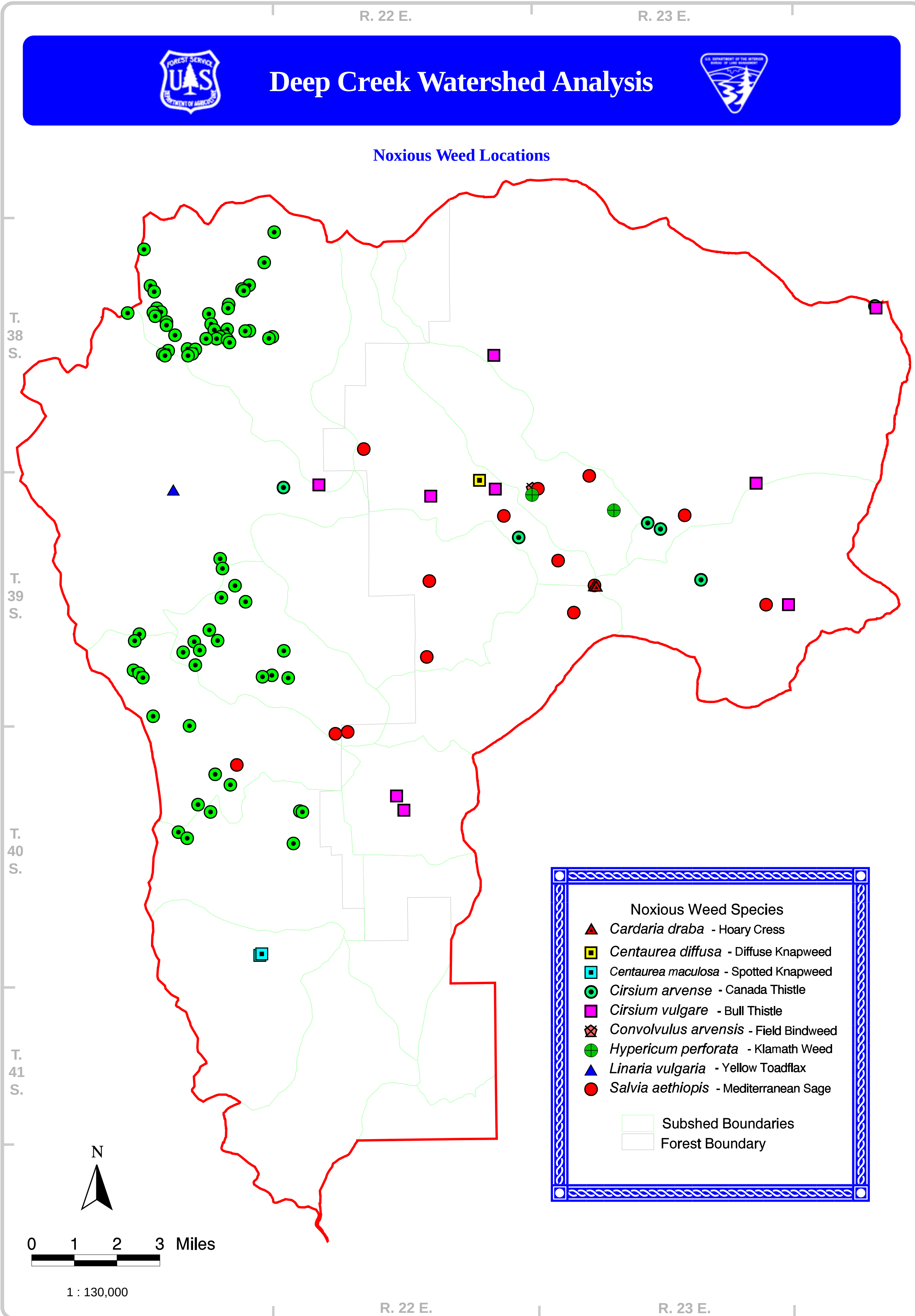
Locator Map



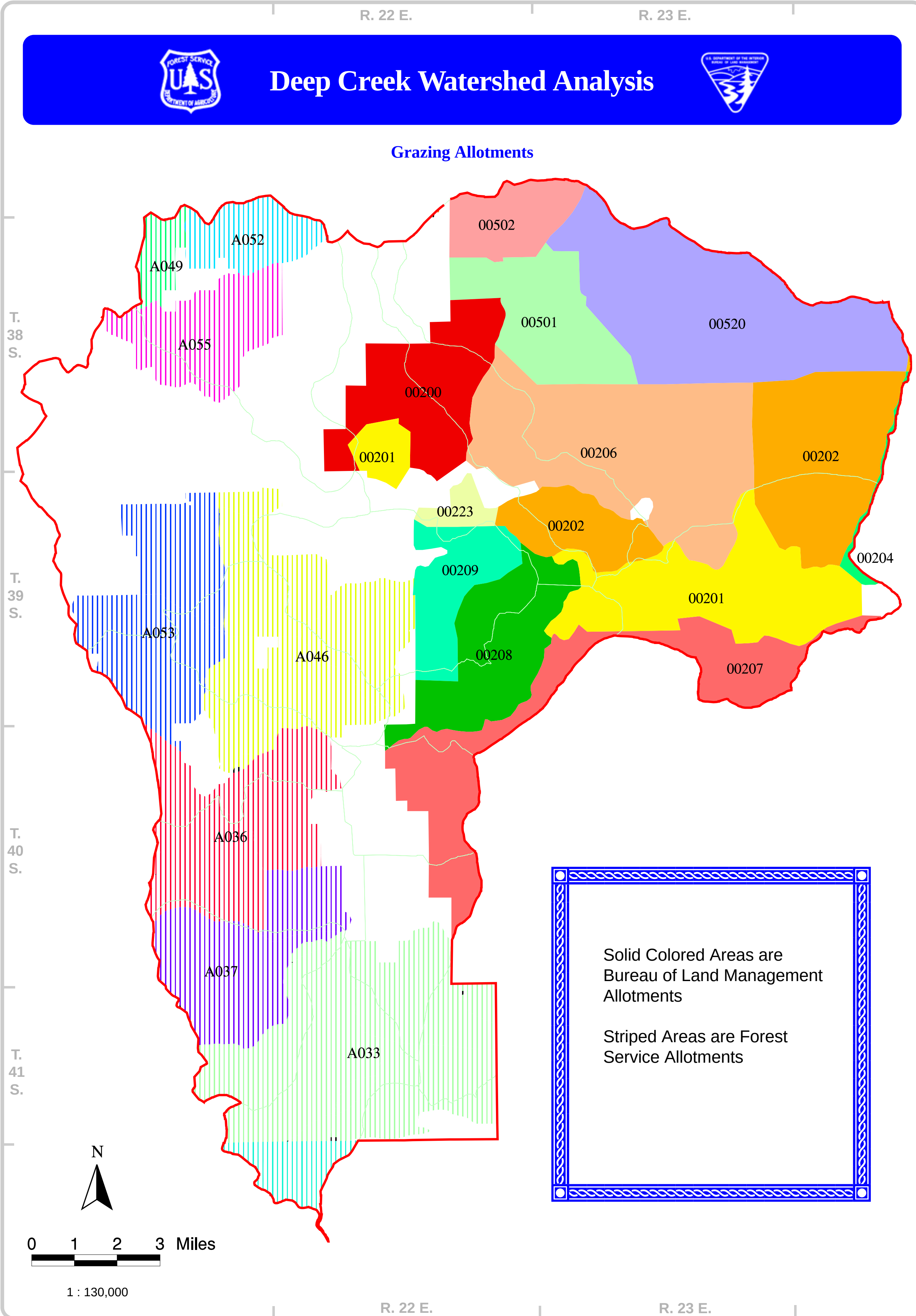
Map 1 - Locator Map



Map 3 - Special Management Areas



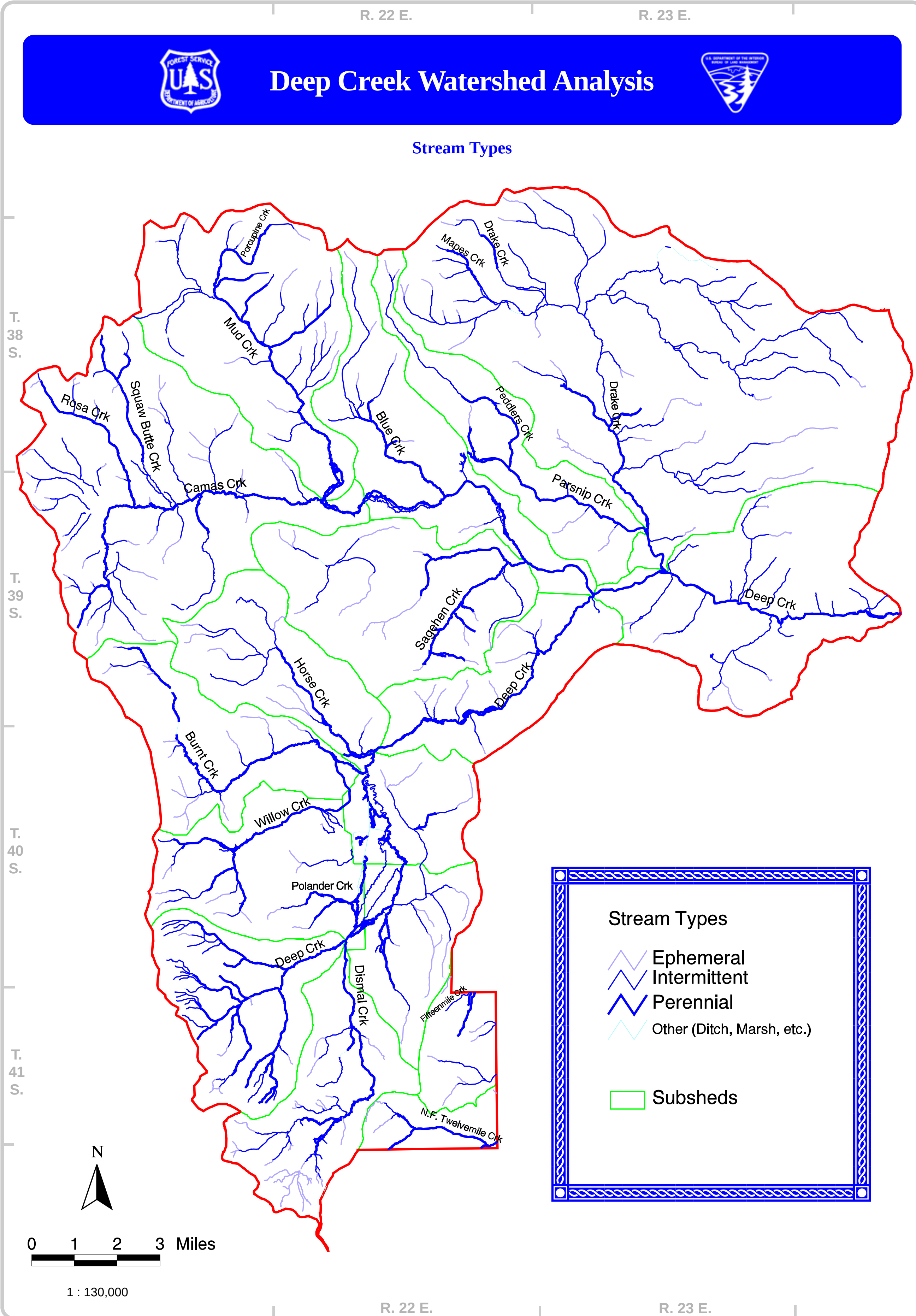
Map 5 - Noxious Weed Locations



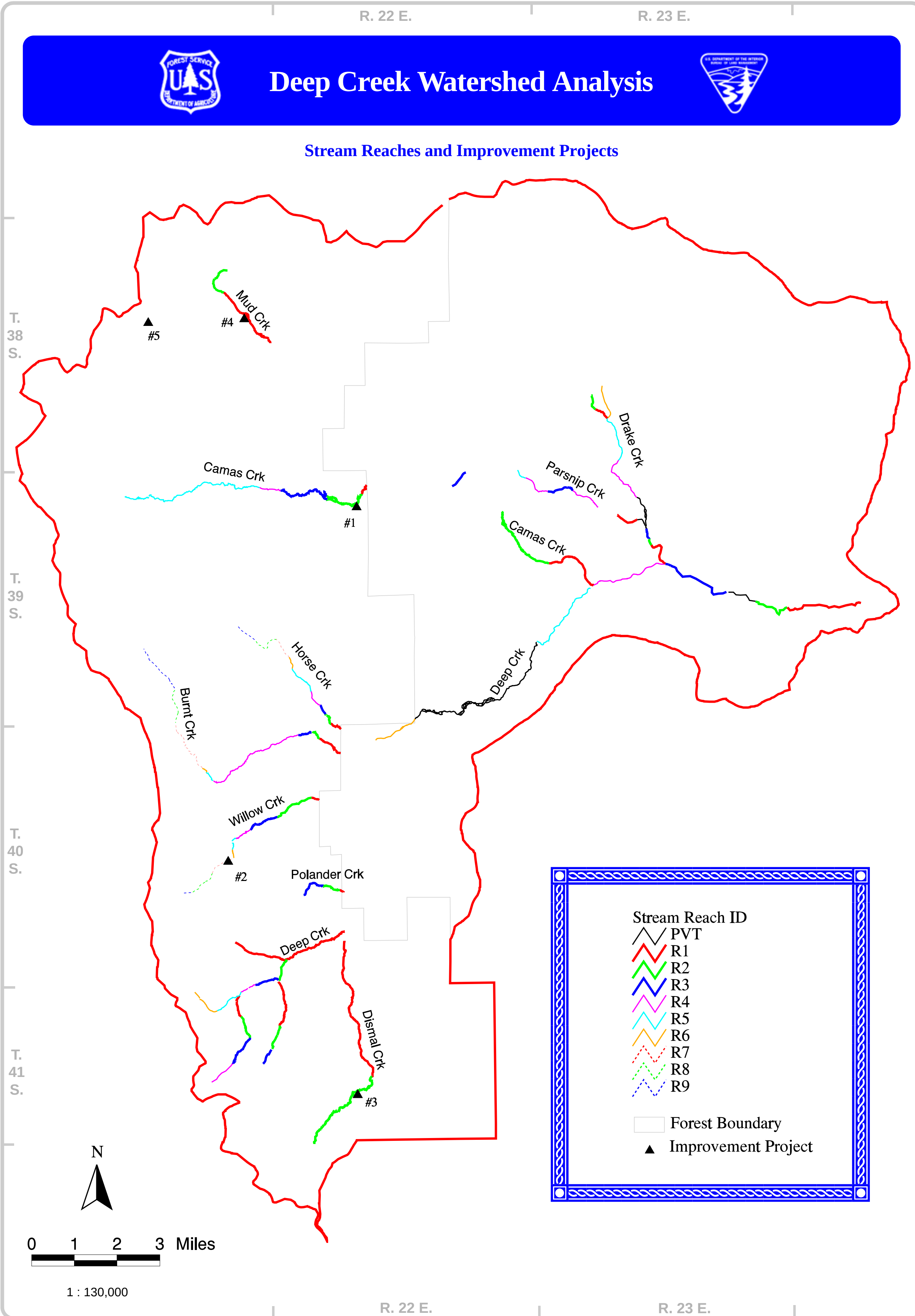
Map 6 - Grazing Allotments

Deep Creek Watershed Analysis

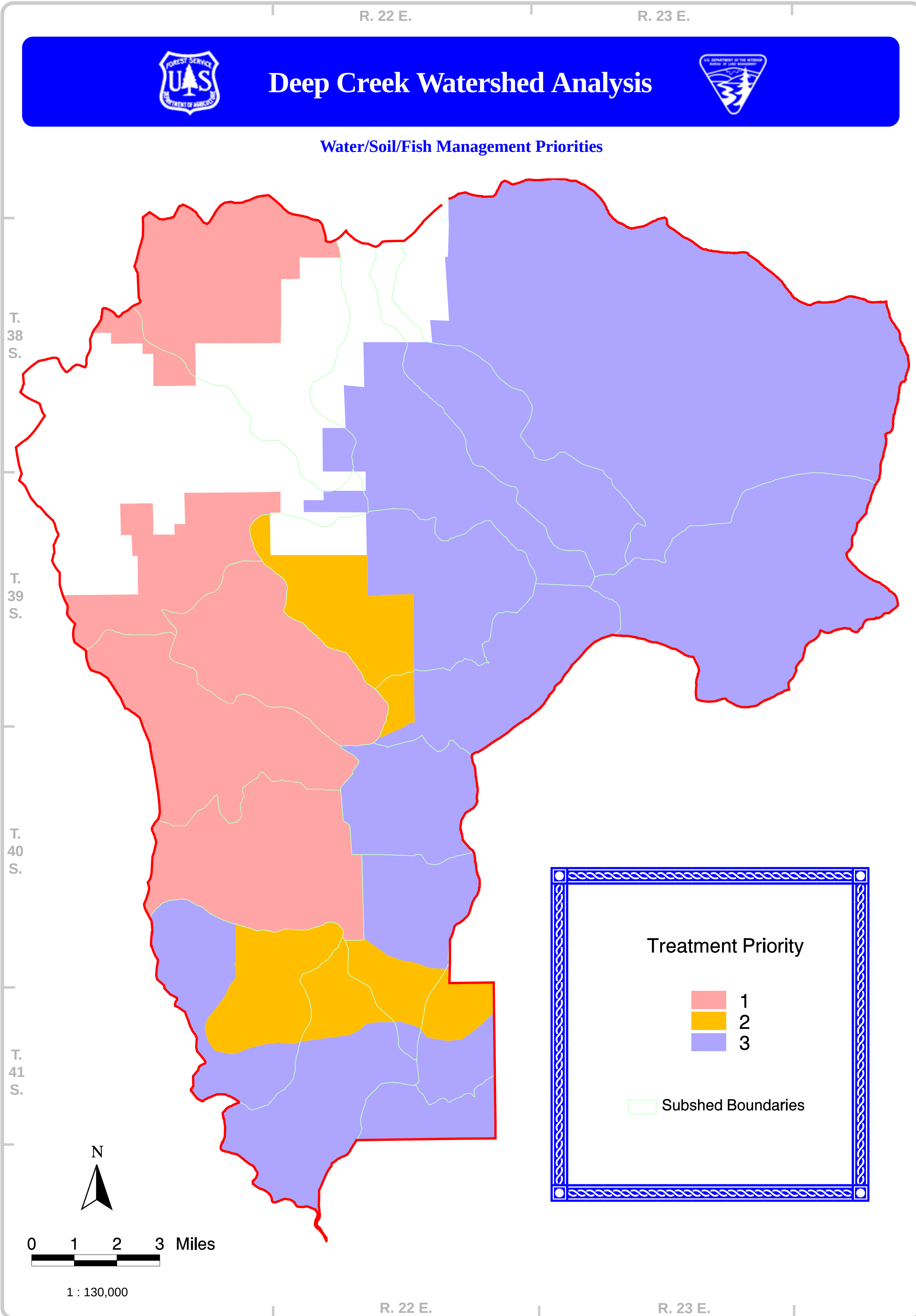
Stream Types



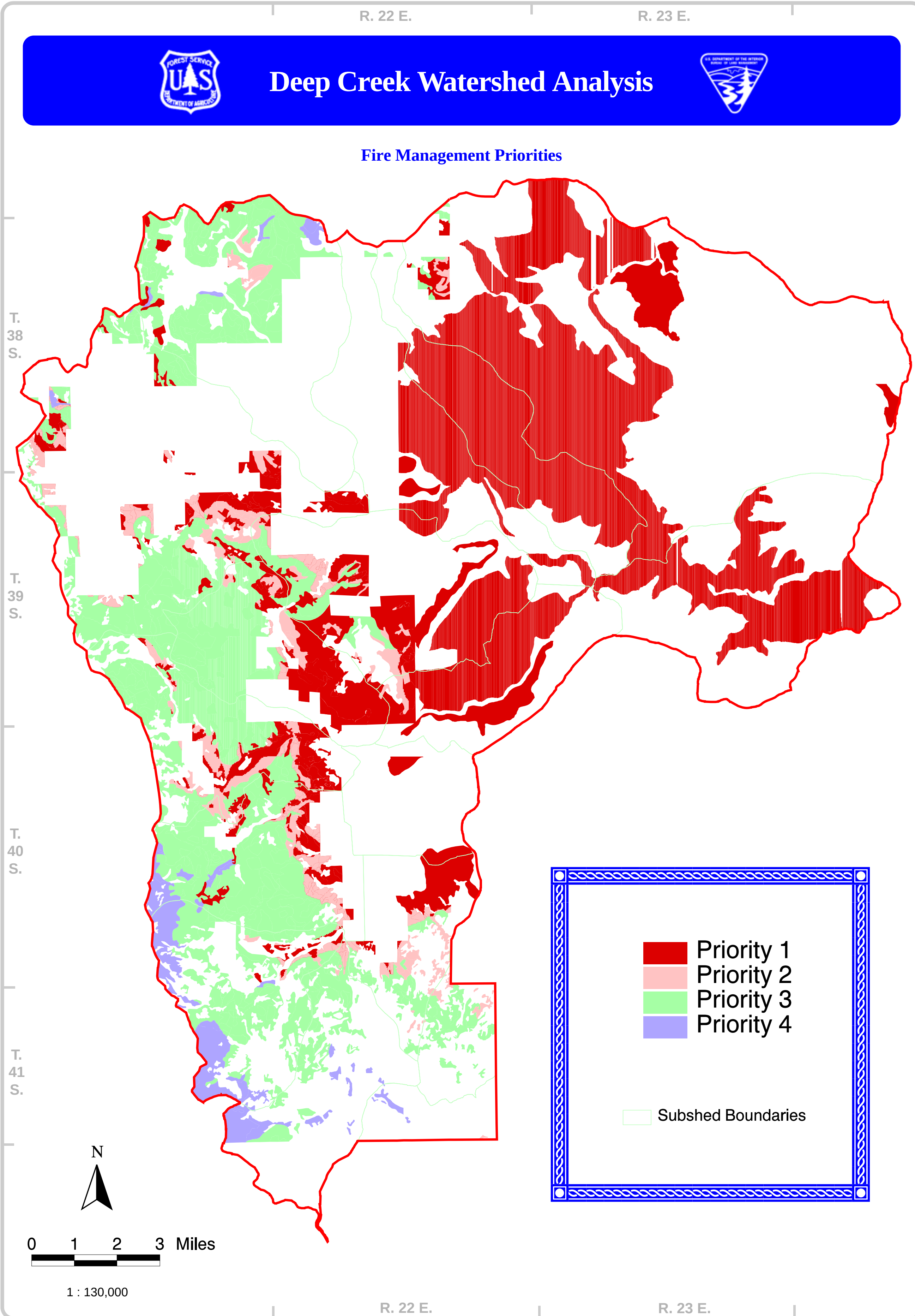
Map 7 - Stream Types



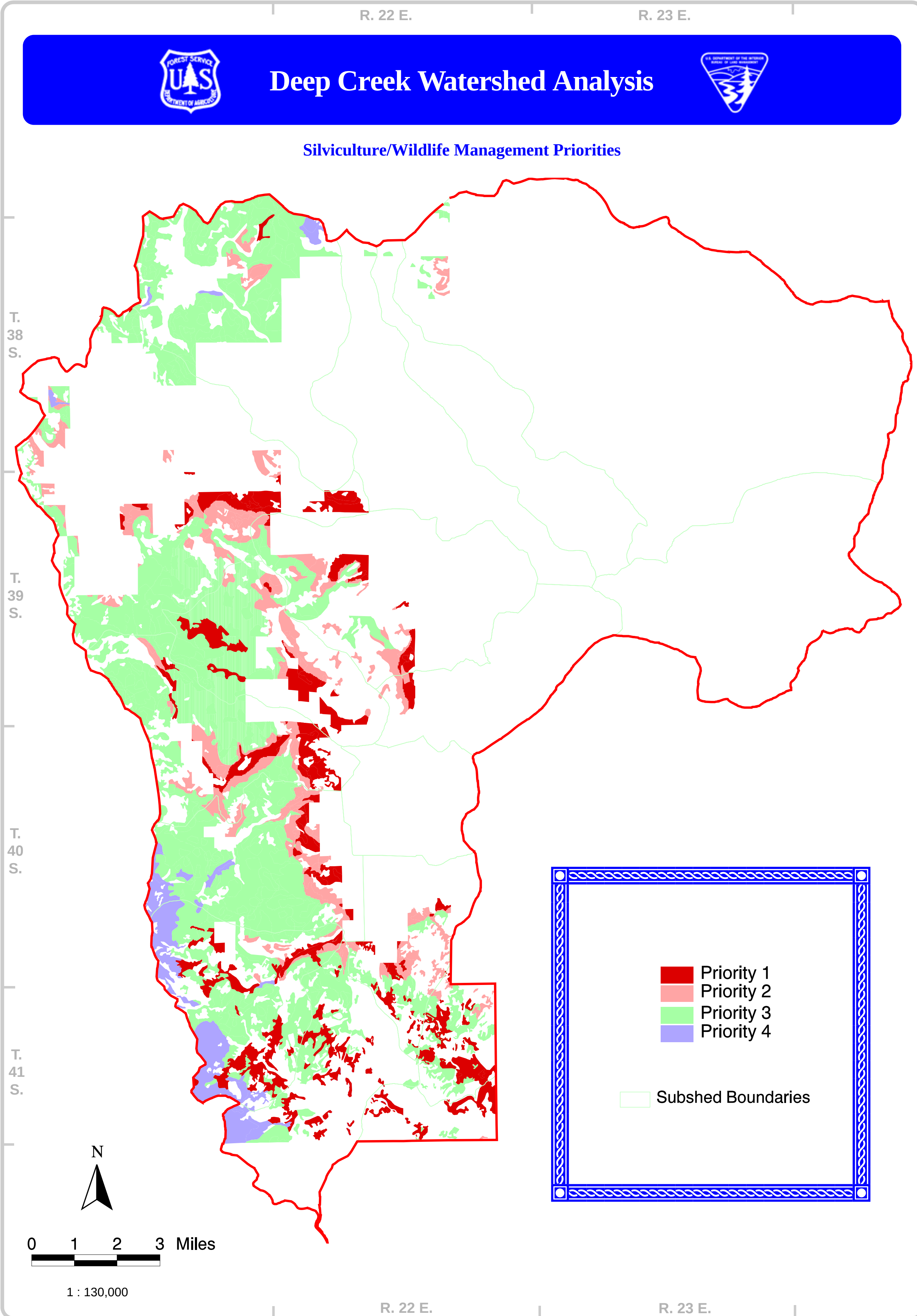
Map 9 - Stream Reaches and Improvement Projects



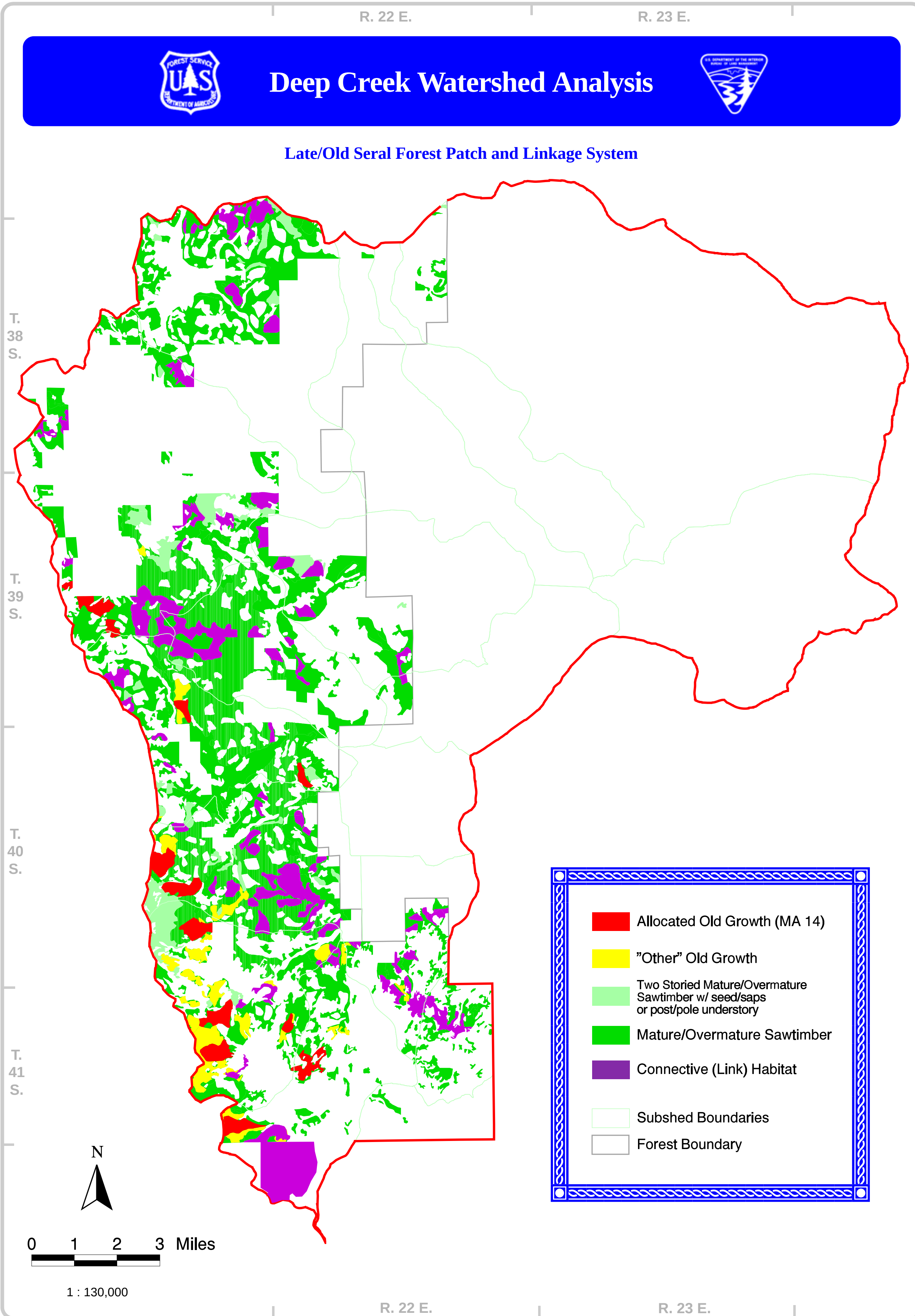
Map 10 - Water/Soil/Fish Management Priorities



Map 11 - Fire Management Priorities



Map 12 - Silviculture/Wildlife Management Priorities



Map 13 - Late/Old Seral Forest Patch and Linkage System

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