WATERSHED ANALYSIS REPORT
FOR THE
NORTH FOURMILE WATERSHED

KLAMATH RANGER DISTRICT
WINEMA NATIONAL FOREST
KLAMATH COUNTY, OREGON
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WATERSHED ANALYSIS REPORT FOR THE NORTH FOURMILE WATERSHED

I. INTRODUCTION

This report documents an analysis of the North Fourmile Watershed. The watershed includes the drainages of Fourmile Creek, Lost Creek, and Horse Creek, which are divided into three subwatersheds: Fourmile Creek; Fourmile Creek above Seldom Creek; and Lost Creek. The Lake of the Woods Basin/Seldom Creek and Varney Creek drainages, which flow intermittently into Fourmile Creek from the south, are not included here and will be addressed in a separate report. The purpose of the analysis is to develop a scientifically-based understanding of the processes and interactions occurring within the watershed and the effects of management practices. The analysis focuses on issues concerning values and uses specific to the area. These issues form the basis for discussions of the interactions between land-use activities, the physical environment, and its biological components. A detailed outline can be found in "Ecosystem Analysis at the Watershed Scale", Version 2.2. The analysis was conducted by a four-member core team consisting of a fish biologist, soil specialist/hydrologist, wildlife biologist, and botanist/ecologist. Many others were consulted during the process (See Appendix A). The analysis was limited by the use of existing information.

Specific objectives of the analysis are to:

1.Provide information and recommendations for management and project planning.

2.Define riparian reserves necessary for maintaining hydrologic, geologic, and ecologic processes.

3.Guide restoration and monitoring work in the watershed area.

II. CHARACTERIZATION OF THE WATERSHED

A. Social and Economic Resources

1. Location and Land Management

The 36,159-acre watershed extends from the crest of the southern Oregon Cascades and top of Pelican Butte to the marshlands near Pelican Bay of Upper Klamath Lake (Figure 1). The Fourmile Creek subwatershed drains the southern slope of Pelican Butte and includes the lower portion of Fourmile Creek, from its mouth to the confluence with Seldom Creek. The Lost Creek subwatershed extends between the crest of the Cascades on the west and the top of Pelican Butte on the east. It includes Lost Creek and Cold Springs Creek. The Fourmile Creek above Seldom Creek subwatershed lies west of the other two, and includes Fourmile Lake, the upper section of Fourmile Creek, and Horse Creek. The eastern slope of Mt. McLoughlin is included in the Fourmile Creek above Seldom Creek subwatershed. See Figure 2.

System (NFS) lands, the majority being on the Klamath Ranger District of the Winema National Forest. The eastern flank of Mt. McLoughlin (845 acres) lies within the boundaries of the Rogue River National

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Forest. Tracts of privately owned land are located in the lower portions of the watershed, including the Fourmile Flat and Rocky Point areas. Private land totals 1,051 acres and includes residences, small acreages, agricultural lands, and forested lands owned by the Weyerhaeuser Company.

Approximately 12,417 acres (34%) of the watershed lie within the boundaries of Sky Lakes Wilderness.

Late successional reserve (LSR) R0227 is located along the southern slope of Pelican Butte and continues west and south through the watershed to the Lake of the Woods Basin. Approximately 11,018 acres of LSR are present in the watershed. Figure 3 shows the management areas within LSR. Matrix lands comprise all areas outside of LSR and wilderness. Matrix management areas include scenic, timber, riparian, developed recreation, bald eagle habitat, and semi-primitive recreation located on Pelican Butte (Figure 4). Little timber harvest or road construction has occurred in the semi-primitive recreation management area.

2. Heritage Resources

Past inventory surveys have documented 45 discrete archeological sites relating to the area's history of settlement and use by both Indian and Euroamerican peoples. Additionally, some 30 miles of railroad grade is extant within the watershed, representing industrial scale exploitation of the area's timber resources. Identified themes of human occupation of the area include American Indian occupations, transportation development, and industrial scale timber exploitation, which is discussed under Issue J.

a. Indian Peoples

The Klamath occupied a large territory comprised of the upper Klamath Basin, as well as areas to the north and east. Divided into about five distinct groups, the Klamath are estimated to have numbered in the several thousand by the time Euroamerican exploration and settlement of the region began. While the largest populations of Klamath lay along the east and south shores of Upper Klamath Lake, a small population, the gu'mbotkni, was concentrated in the resource-rich marsh/lake shore areas near present day Rocky Point (the Klamath name gu'mbot is a geographic reference to Pelican Bay).

The gu'mbotkni, like other Klamath peoples, subsisted largely on lake and marsh resources, primarily fish and water lily (wokas) seeds found in Pelican Bay, Crystal and Recreation Creeks, and elsewhere on Upper Klamath Lake. Fish thrived in these waters, particularly salmonids and suckers. Although these resources may not have been concentrated within the North Fourmile Watershed, the hydrologic systems of the watershed are likely to have affected fish stocks in Pelican Bay. Plants such as camas (Camassia quamash), epos (Perideridia sp.), and Yarrow (Achillea millefolium), found in moist/wet meadow habitats around Fourmile Creek were used to supplement the staple resources. Lists of plant resources utilized by the Klamath can be found in Spier, 1930, and Coville, 1897.

A large portion of the watershed is made up of the south and west slopes of Pelican Butte. This mountain is of undetermined significance to the Klamath. As a landscape feature, Pelican Butte is visible from many surrounding areas. There are several vision quest sites, which suggest that the area was used traditionally in the past for religious purposes. One vision quest site is

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located near the summit. Sites near the base may be places where preparatory `cleansing' took place before ascending to the top.

Other sites found within the watershed typically are lithic scatters, which are locations of dispersed stone tools and debris from their manufacture. While the specific function of these sites is unclear, they probably represent locations of temporary camps, or sites where various food resources were harvested and processed.

At this time, the condition of prehistoric sites (lithic scatters, vision quest sites, etc.) appears to be relatively stable and not at risk.

b. Euroamerican Peoples and Transportation Routes

While much of southwest and southcentral Oregon was being explored by Euroamericans in the early part of the 19th century, little documentation exists of ventures into the area between Upper Klamath Lake and the Cascade Summit (including the North Fourmile Watershed) until the 1860's.

The earliest well documented push into this region was the construction of the "Rancheria Trail", also known as Drew's Road, which was a military supply route linking Jacksonville with the newly established Fort Klamath. During 1862, Captain C.S. Drew scouted and constructed a route that skirted north of Mt. McLoughlin across the Cascade Summit, near Twin Ponds and Fourmile Lake, and then descended eastward into the Fourmile Creek drainage until it turned north along the west shore of Upper Klamath Lake near the mouth of Fourmile Creek. This trail was used from 1863-1864 until a more serviceable route was constructed (now Highway 62). While portions of this trail are extant, much of it has either deteriorated or is now overlain by modern roads (such as a portion of Highway 140 and various Forest Service roads). One portion of the trail within Sky Lakes Wilderness has been listed on the National Register of Historic Places, and other segments of the trail form a part of the wilderness trail system extending from Fourmile Lake to the Twin Ponds area.

In addition to Drew's Road, a wagon route from Ashland was constructed sometime in the late 1800's. This route followed what is now called Dead Indian Memorial Road. For the most part, only small segments of the original road still exist today, and many of these are indistinguishable from other roads built in the area over time.

A wagon route/trail from Klamath Falls connected with Drew's road near Rocky Point. This travel route was appropriately called the "Westside of the Lake Trail" and was in use at the time that Drew constructed his road from Jacksonville to Fort Klamath. Only a small portion of this trail is within the watershed and, like the other routes, has largely been obliterated over time from neglect or construction of new road systems.

3. Timber

Some of the first sales in Forest Service history were conducted in the North Fourmile Watershed. The south and southwest slopes of Pelican Butte, Fourmile Flat area, and the lower Lost Creek drainage were harvested early in the century. This area was chosen because of the amount and quality of large ponderosa pine. By 1950, over 6,000 acres had been high graded.

Timber harvest records for the past 30 years are displayed in Figure 5.

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Harvest has occurred over most of the tractor ground in the white fir and lower Shasta red fir zone, and many stands have been entered more than once. Harvest was greatest in the 1960's, when partial removals were conducted on almost 20% of the non-wilderness area of the watershed. Lower levels of partial removals and shelterwood harvests occurred during the 1970's. Firewood cutters also removed a large amount of dying lodgepole in the Lost Creek subwatershed in the 1970's. In the 1980's, thinnings, overstory removals, and shelterwood cuts occurred. Primarily thinnings and overstory removals were done in the 1990's. One of the objectives of harvest in the 1990's was to improve forest health by decreasing insect-caused mortality, maintaining large ponderosa pine, and reducing fuel loads in the lower portions of the Fourmile drainage.

4. Roads

The road system in the North Fourmile Watershed was developed relatively early compared to other parts of the District. As described above, the Jacksonville to Fort Klamath road ran through the watershed in the mid 1800's. Early settlement in the Rocky Point area also prompted road development in the lower Fourmile drainage. Near the turn of the century, a road was built into Fourmile Lake to construct the Fourmile Lake Dam and Cascade Canal. In the 1930's, a road was constructed up the Lost Creek drainage and west side of Pelican Butte to access a fire lookout station on the summit.

Despite the early development, road densities in the North Fourmile Watershed are relatively low, compared to other parts of the District. This may be because of the low value of timber in the Lost Creek subwatershed (resulting from past fires), and rocky slopes (less suitable for logging) on the west side of Pelican Butte. Total road density in watershed outside wilderness is 2.72 miles of road per square mile. Open road density is slightly lower, at 2.27 miles per square mile. This compares with 3.5 to 4.0 miles per square mile of total roads in the Threemile, Sevenmile, and Dry Creek watersheds. Road density within riparian reserves is also lower than in the Threemile/Sevenmile/
Dry area. Total road density in non-wilderness riparian reserves is approximately 2.3; open road density, 2.0.

5. Agriculture/Grazing/Irrigation

Currently, the Forest does not administer any grazing permits in the North Fourmile Watershed. Allotments at Big Meadows and Pelican Barn were grazed from approximately 1934-1981 and 1916-1980, respectively. The District continued to use the Pelican Barn pastures for horse grazing until 1991. In the late 1800's and early 1900's, it is likely that unregulated grazing occurred over most of the watershed.

Private lands in the lower Fourmile drainage continue to be grazed. These include meadows and timbered stands located west, north, and south of Pelican Barn. In the past, some of the meadows in the lower Fourmile drainage were also used for hay production.

In 1910, the Fish Lake Water Company applied for a permit to construct a dam on the outlet of Fourmile Lake. During this process, they claimed water held in the reservoir and the water in tributaries which filled the lake. The dam on Fourmile Lake was constructed 35 feet in height and raised the lake water height 30 feet. The Cascade Canal was built to divert water from the lake to the west side of the Cascades for irrigation of crops in the Rogue Valley.

Downstream of NFS lands in Sections 9 and 10, water in Fourmile Creek is claimed and used to irrigate small pastures.

6. Recreation

The watershed provides many opportunities for recreation and includes some of the most frequently visited areas on the District. Approximately 39,000 visitor occasions occurred in 1995. Data indicate an increasing trend in visitor use, although the 1995 data represent an 8% decrease (probably a result
of weather conditions). Use is expected to increase by 65% over the next five years, due to population growth in Klamath Falls and the Rogue Valley.

Summer activities include hiking, backpacking, camping, horseback riding, boating, swimming, hunting, and fishing. Within wilderness, the Mt. McLoughlin Trail is a popular day hike. The Twin Ponds and Badger Lake Trails which emanate from Fourmile Lake provide opportunities for day hikes to nearby wilderness lakes. The Lost Creek and Cold Springs Trailheads are also located within the watershed.

The Fourmile Lake Campground is a 25-unit fee site with full occupancy nearly every summer weekend from July to September. Small non-fee developed sites are located at the Cold Springs Trailhead. The Fourmile and Rye Spur Rock quarries are popular dispersed camping sites. Hunters also frequently use dead-end spur roads for camping.

Snowmobiling is the main winter recreation activity. About 19 miles of snowmobile trail are present, including portions of the Fourmile Lake, Diamond Lake, Pelican Butte, and Old Pelican Butte Trails. Big Meadows is a popular gathering area for snowmobilers. An historic barn near the meadow is used as a warming hut and has been proposed for renovation. Other winter activities include cross-country skiing and snowplay.

B. River Basin Context

The North Fourmile Area is comprised of three 5th-field watersheds and is a part of the Upper Klamath Lake sub-basin, which is a headwater sub-basin for the Klamath River Basin. Water from the watershed drains into Fourmile Creek and enters Pelican Bay of Upper Klamath Lake at Harriman Springs.

The Upper Klamath Lake sub-basin has been the focus of several environmental issues in recent years. Species of fish in the basin have declined, and others have been extirpated. Contributing factors include: damming of rivers; instream flow diversions; draining and dredging of marshes; and competition, predation, and hybridization with exotic species. Currently, two fish species in the basin are listed as endangered, and four species are on the Regional Forester's sensitive species list. Species of salmon and steelhead have been extirpated from the upper sub-basin by dam construction on the Klamath River (Fortune, 1966).

A majority of issues in the river basin center around water quality degradation. Activities associated with agriculture, such as the regulation of lake levels, reclamation of wetland habitat, application of chemicals, and diversion/irrigation practices, can be correlated with decline of water quality in Upper Klamath Lake (U.S. Geological Survey, 1993). Water quality in the lake is often poor, with elevated pH levels, wide fluctuations in dissolved oxygen and carbon dioxide levels, and high water temperatures. Although the

lake was historically eutrophic, Upper Klamath Lake is now classified as hypereutrophic, most likely a result of human-caused changes which have increased the level of nutrient and energy inflow into the lake over background levels (U.S. Fish and Wildlife Service, 1993). High nutrient levels promote large blooms of the algae Aphanizomenon flos-aquae. These massive blooms cause extremely stressful conditions for fish, with pH values in excess of 10.0 and dissolved oxygen concentrations near 0 mg/l (U.S. Fish and Wildlife Service, 1993, 1994). Because water quality conditions within the main body of the lake can be stressful, if not lethal, to aquatic organisms, mass movement of fish to areas with fresh influxes of water occurs during summer months. This is a significant link between the North Fourmile area and Upper Klamath Lake. Fourmile Creek contributes intermittent flow to Pelican Bay, an area that has been identified as important refugia habitat for fish during stressful summer conditions (U.S. Fish and Wildlife Service, 1994).

Other aquatic organisms that inhabit Pelican Bay or Harriman Springs, such as invertebrates or algae, could also be influenced by the quality of water being produced in the North Fourmile Watershed and the timing and/or amount of sediment it delivers.

A wide variety of freshwater invertebrates, including clams, mussels, and snails, occur in the Klamath Basin. Recent surveys indicate the Forest has a high diversity of mollusks, including taxa which occur in few other places in the world. Some recently discovered species have never been described. Future surveys may reveal even more undescribed and/or endemic species.

Invertebrate abundance and diversity are often highest in large, clear spring pools or spring-fed streams, such as Harriman Springs, that contain cold, well-oxygenated water. Mollusks are an important component of the aquatic ecosystem. They serve as a food source for fish, larger aquatic invertebrates, birds, and various mammals. They are primarily herbivores or detritivores and function to cleanse aquatic systems of detritus, ensuring that water quality parameters are maintained. Because of their life history requirements and ability to concentrate water-borne toxins, these invertebrates make effective indicators of pollution and other forms of environmental disturbances (Gowan, 1996).

Another species of concern is a colonial blue-green alga, known as Mare's Eggs (Nostoc pruniforme), which occurs at the mouth of Fourmile Creek at Harriman Springs. Although Nostocs have scattered world-wide distribution, the large size of the colonies at this site is a rare occurrence. During drought years, the colonies are at risk, as lake levels recede and drain their habitat.

C. Physical Features

1. Erosional Processes and Soils

The dominant erosional occurrences in the North Fourmile Watershed result from surface erosion, including overland flow, rilling, and gullying. Surface erosion of forested areas usually follows intense rainstorms or excess surface flows. The chief variables in surface erosion are the inherent erodibility of the soil, slope steepness, surface runoff, slope length, and ground cover. Surface erosion can be the major source of sediment delivered to streams in sensitive terrain. Listed below are the soil landtypes found in the watershed area and some of their inherent qualities.

Unnamed soils of the "X" group (Carlson, 1979) formed from glacial till in the uplands of Sky Lakes Wilderness and bottoms of the Fourmile, Lost, and Horse Creek drainages, where slope gradients are less than 35% (see Figure 6). This group consists of well-drained gravelly to very gravelly and cobbly sandy loams and loamy sands. Gravel, cobble, and stones make up 15-75% of the soil material. Depth to bedrock is generally greater than 40". However, in many areas, impervious dense glacial till or mudflow material underlies the soil at fairly shallow depths. This limits rooting depth and water storage space and increases the chance for runoff.

Unnamed soils of the "R" group, derived from a mixture of volcanic ash, weathered andesites, basalts, mudflows, and pyroclastics, are found on the upper to lower slopes in the watershed area. The R group consists of well-drained gravelly and cobbly fine sandy loams and loam soils. Gravel, cobble, and stones make up 10-75% of the soil material. Slope gradients range from 0-70%. Soils on concave slope positions tend to be less rocky, while those on steeper slopes are higher in coarse fragments. Depth to bedrock is generally greater than 60 inches and rooting depth, 20-40". R group soils have the highest productivity potentials of any on the District and the greatest potential for reduction in productivity due to management activities (Carlson, 1979). Soils with more than 60% coarse fragment content are unplantable and difficult to regenerate. Soils with less than 50% coarse fragment content are susceptible to compaction when moist. Soils on steep slopes have a potential for severe sheet erosion.

Landtypes in the lower Fourmile drainage, where Fourmile Creek approaches Upper Klamath Lake, have slopes of 0-15%. Cobbly glacial outwash material was deposited in the Fourmile Flat area, forming landtypes 7 and 9. Soils in this area are gravelly to very gravelly and cobbly sandy loams and loams. The coarse fragment content is 20-50%. Depth to bedrock is greater than 96". Landtype 7 is somewhat poorly drained, while landtype 9 is well to moderately well drained. Landtypes 2 and 10 occur around the edges of the outwash material and adjacent to Upper Klamath Lake. These landtypes include flat to gently sloping valley and stream bottoms which are somewhat poorly drained. Soils are deep sandy loams to loam and gravelly sandy loams. Erosion hazard is low and compaction hazard is low to moderate for these landtypes, except for landtype 2, which is susceptible to gully erosion and has a high compaction hazard.

Landtypes 17, 18, 19, and 20 are located on the sideslopes of cindercones. These landtypes are located on parts of Pelican Butte and small unnamed knolls. Soils are excessively drained very gravelly loams to cobbly sandy loams. Erosion hazard can become severe on slopes greater than 35%.

2. Hydrology

Each subwatershed has unique qualities that affect hydrologic processes. Hydrologic processes within the three subwatersheds are dominated by geologic structures and forms. Stream flows and stream densities are directly related to the type of sub-surface parent materials present.

In the Fourmile Creek subwatershed, Pelican Butte is a cinder cone with high infiltration rates, low stream densities, and low instream flows. Only intermittent channels are found on Pelican Butte. The lower reaches of the Fourmile drainage are predominantly influenced by deposited glacial till. The unconsolidated glacial material is easily transported by water, which has resulted in transient channels that migrate across the valley bottom.

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The Lost Creek subwatershed is located between Pelican Butte and Mt. McLoughlin. The two mountains have induced a fluctuation in the climate of this area. Precipitation is high and temperatures are cool. Soils have a shallow depth to dense glacial till or bedrock in much of this subwatershed. The combination of climate and soils results in numerous springs and moist meadows, and increased drainage density.

The Fourmile Creek above Seldom Creek subwatershed is influenced by parent material similar to that described for the Lost Creek subwatershed. Fourmile Creek begins at Fourmile Lake, a high elevation mountain lake created during the late Pleistocene Epoch by glacial advancement. Glacial action scraped off the majority of top soil in the area; as a result, Fourmile Lake and adjacent lands have a shallow soil depth to bed rock or impervious material. These past events and resulting soils have reduced the water holding capacity in the area, and a dense drainage network can be seen throughout the upper reaches of the Fourmile Creek above Seldom Creek subwatershed. (See Figure 7.)

3. Stream Channels

The basic morphological characteristics of stream channels in the North Fourmile area were stratified according to the Rosgen Classification System (Rosgen, 1994). The predominant stream types within the analysis area are B2, B3, B4, C3, C4, and C5. Figure 8 shows the location of stream types.

Approximately 45% of the streams in the watershed have been inventoried. Most of these channels (69%) were classified as B-type channels, which includes Lost, Horse, and Upper Fourmile Creeks. Channels with C-type morphology are found in lower Fourmile Creek and comprise approximately 21% of inventoried channels. The remaining 10% consists of a canal in the Fourmile Creek subwatershed, which would be classified as a C-type channel under natural conditions.

Type B channels are often associated with narrow, sloping valleys. In general, they are moderately entrenched, riffle-dominated systems with infrequently spaced pools. This is characteristically a very stable system that has a low-to-moderate sensitivity to disturbance and an excellent recovery potential. Overall, B-type channels are in good condition throughout the watershed.

Type C channels are often associated with broad valley landforms marked by distinct terraces and floodplains. Predominant features of this stream type include a low gradient, a high sinuosity, and riffle-pool sequences. This stream type is very susceptible to shifts in both lateral and vertical stability caused by changes in flow and sediment regime in the watershed, and to direct disturbances. Vegetation of streambanks is the key factor in controlling bank stability. As a result, sensitivity to disturbance is very high, with a fair-to-good recovery potential. As a result of channelization and grazing, many of the C-type channels are currently in a degraded condition.

4. Water Quality

Overall, water quality is believed to be good throughout most of the watershed, and has not been identified as an issue in the upper reaches of Fourmile Creek nor any of its tributaries. However, sediment loading within the lower reach of Fourmile Creek may be occurring above natural levels. Sediment loads in Fourmile Creek downstream of private property were observed to be much higher than upstream of the private land during a storm event. This may be a result

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of disturbance from grazing. Additionally, within this same reach, the creek has been channelized on both NFS lands and private property. The streambanks are in a constant state of instability, contributing to sediment loading. Quantifiable data on sediment loading should be collected in the future to verify the significance of these observations.

The importance of the quality of water leaving the watershed is discussed in detail under Section II B., River Basin Context.

D. Biological Features

1. Vegetation

Four different forested vegetation zones occur in the watershed (Figure 9). Each contains more than one locally recognized plant association as described by Hopkins (1979). Non-forested communities occur on rock outcrops and talus slopes, in seasonally moist to wet meadows (generally dominated by tufted hairgrass or various sedges), and in small lakes and shallow ponds.

a.Whitebark Pine

The white bark pine zone occupies approximately 725 acres near the tree line on Pelican Butte and Mt. McLoughlin. Plant associations have not been identified in this zone. Associated species are mountain hemlock, lodgepole pine, subalpine fir, and Shasta red fir. The best development of the forests occur on south-facing slopes. Shrubs include common juniper and Green's golden bush.

Cover is often sparse (canopy closure 11-40%) and trees are often short and stunted. Rock and talus create discontinuities in the forest.

Because of the loss of whitebark pine in some regions, interest in potential breeding programs for blister rust resistance and the distribution of genetic variation in the species has arisen. Analysis of samples collected on the District indicate the Mt. McLoughlin population is genetically similar to other populations on the District, while the Pelican Butte population is more closely related to populations on Mt. Shasta and Mt. Lassen to the south.

b. Mountain Hemlock

The mountain hemlock zone comprises approximately 16,816 acres located on cold or high elevation sites, including most of Sky Lakes Wilderness near the Cascade crest, the Cold Springs basin, and Pelican Butte. Forests in this zone generally have low species diversity. Mountain hemlock is the dominant overstory species, with Shasta red fir and western white pine as minor components. In many places, the mountain hemlock zone is difficult to distinguish from the Shasta red fir zone, and may have been inaccurately mapped for this analysis. Stands with both mountain hemlock overstories/Shasta red fir understories and Shasta red fir overstories/ mountain hemlock understories are common (pers. comm. Rod Johnson). Lodgepole pine is seral. Grouse huckleberry, big huckleberry, and pinemat manzanita typically form the shrub layer.

Forests on glaciated topography are broken up by numerous small meadows and pothole lakes. Lava flows and talus create openings on the slopes. Several stands in the zone have sparse growth and low canopy cover due to harsh site conditions.

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c. Shasta Red Fir

Shasta red fir-dominated forests are located on mid to upper slopes, in the upper Horse Creek drainage, and in the middle reaches of the Lost Creek Drainage. Elevations are generally above 5,000'. Approximately 7,500 acres lie in this zone. Forests in this zone are variable. On cold, high elevation sites, diversity is low. Mountain hemlock and western white pine are common associates of Shasta red fir, and lodgepole pine is seral. Pinemat manzanita and long stolon sedge form most of the sparse ground cover. In mid elevation forests, white fir, Douglas-fir, and ponderosa pine are common associates. Shrubs such as chinquapin and snowbrush inhabit disturbed sites. Herbaceous cover is more extensive and diverse. Forested riparian areas in this zone often have significant amounts of white fir, Engelmann spruce, Douglas-fir, and mountain hemlock.

On mid slopes, forests are relatively dense and continuous. Small-sized openings exist where past disturbance has created brush fields. Forests are less dense on upper elevation rocky sites and are often interrupted by lava flows and talus.

d. White Fir

The white fir zone occupies the lower to mid slopes and drainages, covering roughly 10,283 acres. It extends to approximately 5,000' elevation in the North Fourmile area, except on the south-facing slope of Pelican Butte, where white fir forests are found up to 5,500'. Upslope and north-facing forests are primarily white fir dominated, while those on the lower, east, and south-facing slopes contain mixes of white fir, ponderosa pine, Douglas-fir, and sugar pine. Diverse shrub and herbaceous species occur under partial canopies, particularly on mesic sites. Snowbrush, green manzanita, and chinquapin occupy disturbed sites. A poorly-defined, highly variable, and diverse white fir-alder association occurs along the creeks.

On the lower slopes, forests are relatively continuous, interrupted by patches of brush from past disturbance. Stands are dense and continuous in the steeper drainages. The broad floodplains of the lower Fourmile Flat-Rocky Point area contain a mosaic of dense and open forests interspersed with meadows and clumps of willow and aspen.

2. Plants

a. Sensitive Species

Appendix B shows potential habitat and the likelihood of occurrence in the watershed of vascular plant species on the Regional Forester's sensitive species list, documented or suspected to occur on the Winema National Forest. Past surveys in 1990, 1992, and 1994 covered approximately 60% of the watershed area, including portions of Sky Lakes Wilderness. Six of the species on the Regional Forester's list were located during those surveys, making this watershed one of the richest in sensitive plants. Issue B discusses in more detail habitat and potential threats for some of the sensitive plant species.

Mt. Mazama collomia (Collomia mazama) occurs throughout the Cold Springs drainage and has spotty occurrence in the Horse Creek drainage. The species also occurs in the Cherry Creek drainage on the District, as well as on the Rogue River National Forest, and in Crater Lake National Park. A conservation strategy is currently being developed for this species.

Newberry's gentian (Gentiana newberryi) also occurs in the Cold Springs and Horse Creek drainages. This species occupies meadows which are wet in the spring and early summer. The largest population is in Big Meadows and numbers several thousand. The plants are typically located on the drier sites around the edges, or on small hummocks. The meadows all fall within riparian reserves, and are currently relatively undisturbed, although they were grazed in the past. It is unknown whether periodic disturbance from grazing or fire is beneficial or detrimental to the species.

Green flowered ginger (Asarum wagneri) is at the northeast edge of its range in the watershed. It occurs near Rye Spur and on the flanks of Mt. McLoughlin and extends south and west through the Lake of the Woods basin and onto the Rogue River National Forest. Ginger plants appear to prefer early seral sites, open lodgepole and fir stands, or old growth stands with gaps, and can be relatively common in these habitats. Plants generally fade out with canopy closure. The species also is found on roadcuts and on open rocky slopes, occurring up to 8,000' on Mt. McLoughlin. A conservation strategy will be finalized in 1996.

Red root yampa (Perideridia erythrorhiza) is the rarest plant on the District. It is known from only two locations, one of which is Pelican Barn. Because it is difficult to distinguish from other similar yampas which also grow at Pelican Barn, population size is unknown, but expected to be small. Habitat requirements are not known, and appear to be different than populations found west of the Cascades. Additional study is needed to manage this species. A challenge costshare with Oregon Department of Agriculture is in place to develop a conservation strategy.

Pygmy monkeyflower (Mimulus pygmaeus) is a tiny annual which occurs in the intermittent channelized portion of lower Fourmile Creek at Pelican Barn. This is the only known population on the District. The species is much more widespread in vernally wet sagebrush habitats on the Chiloquin Ranger District and Fremont National Forest.

A large population of sticky catchfly (Silene nuda ssp. insectivora) also occurs in the vernally wet meadows of Pelican Barn. This is one of two known populations on the District; the species is more common on the Chiloquin District. Experimental prescribed burns are being conducted to determine the effect of fire on the species.

Many of the other sensitive species shown in Appendix B as possibly occurring in the watershed would most likely be found either on high elevation slopes or in riparian areas within Sky Lakes Wilderness.

b.Survey and Manage and Late Successional-Associated Species

Past plant surveys have not located the survey and manage vascular species candy stick (Allotropa virgata) in the watershed. Potential habitat is present. This species exists in large populations in Shasta red fir and mountain hemlock stands in the Threemile and Sevenmile drainages at the northern end of the District.

A special forest product survey was conducted in this area in 1990 and included a brief survey of fungi. Five fungi listed in Table C-3 of the Forest Plan were identified, but not mapped. These include Sarcodon imbricatus, Phaeocollybia scatesiae, Cantharellus cibarius, C. subalbidus, and C. tubaeformis. All five are associated with late successional habitats.

Maintenance of late successional forests inside the LSR should provide habitat for these species. Surveys for lichens and bryophytes have not yet been conducted. Potential habitat may be present for some of the other survey and manage species. Species located outside the watershed in other areas of the Forest include: the fungi Catatheleasma ventricosa, Clavulina cristata, Gastroboletus subalpinus, Gomphus kaufmanii, Gyromitra esculenta, Helvella compressa, , Phlogiotis helvelloides, Rhizopogon evadens var. subalpinus; and the lichens Calicium viride, Chaenotheca furfuracea, Hydrothyria venosa, Peltigera collina. None of the identified species on the Forest require Survey Strategy 2, survey prior to activity, except for candy stick.

Small populations of Pacific yew are located in some of the shady upper drainages of Fourmile Creek. The species is at the eastern edge of its range on the Klamath Ranger District.

c.Communities of Interest

The watershed contains a high density of riparian areas, including several moist and wet meadows. Big Meadows and associated smaller meadows in the Cold Springs basin, the meadows of the upper Horse Creek Drainage, and the meadows of Pelican Barn are most notable for their species diversity. In addition to the sensitive species listed above, other rare species such as Buxbaum's sedge (Carex buxbaumii) and dulichium (Dulichium arrundinaceum) have been located in some of these meadows. All the meadows were grazed in the past, but have retained a high component of native species.

d. Noxious Weeds

St. Johnswort has become common along the Westside Road and in the Rocky Point area. It occurs in spots along Forest Road 3651 and around the Fourmile rock quarry. Small populations of spotted knapweed and dalmation toadflax also occur along the Westside Road and in the Rocky Point area. Spotted knapweed and Canada thistle are located in small sites along Forest Road 3651. Because noxious weed infestation is limited primarily to roadsides, displacement of native species is not currently a concern. Spread to other areas, particularly of St. Johnswort and dalmation toadflax, could occur in the future, if weeds are left untreated. Treatment of noxious weed species in the watershed is addressed in the Winema National Forest Noxious Weed Environmental Assessment. Treatment in the past has been limited by funding and has been relatively ineffective.

3. Aquatic Species

The watershed area provides historic stream habitat for chinook salmon and steelhead, and for the endangered Lost River (Deltistes luxatus) and shortnose (Chasmistes brevirostris) suckers. Current stream habitat exists for brook trout (Salvelinus fontinalis) and the sensitive redband trout (Oncorhynchus mykiss). Potential habitat is present for the sensitive bull trout (Salvelinus confluentus).

Approximately 13% of the watershed is included in the proposed designated critical sucker habitat for Lost River and shortnose suckers (Figure 10). The Fourmile drainage was included in the Critical Habitat Rule proposed by the U.S. Fish and Wildlife Service for several reasons. Lost River suckers historically utilized the mouth of Fourmile Creek at Harriman Springs for spawning and egg incubation. Other areas were selected because they are a part

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of the 100-year floodplain of Upper Klamath Lake, and are important for the provision and maintenance of water quality in Upper Klamath Lake. Large wetlands that were historically connected to Upper Klamath Lake, such as those of lower Fourmile Creek, could have also been utilized as larval and/or juvenile rearing areas for suckers (U.S. Fish and Wildlife Service, 1994). Historic sucker habitat occurred within stream reaches designated as canal, C5, and C4 in Figure 8. Currently, no suckers are known to utilize Harriman Springs or the lower reaches of Fourmile Creek for spawning or rearing.

Brook trout are the most abundant and widely distributed fish species in the watershed (Figure 11). This exotic species was introduced in the early 1900's and has spread throughout the entire system.

A single redband trout was found in reach B4 of Fourmile Creek during fish surveys completed in 1992, and none were found in 1995. Relative abundance and distribution of this species within the watershed cannot be determined until more extensive fish surveys are completed. Habitat exists for this species wherever brook trout are found. Key parameters, such as temperature, water quality, spawning/rearing habitat, and hiding cover, are within acceptable ranges. There are no known barriers to fish passage.

Horse Creek has potential habitat for bull trout. Key habitat parameters, such as cold water temperatures and large wood, are present in this pristine creek. Although brook trout are in Horse Creek, a bull trout population may still occur. If so, this would be a significant discovery within the Klamath Basin. Bull trout within the basin have been reduced to seven isolated populations and are threatened by extinction because of genetic isolation, habitat degradation, and exotic fish introduction.

Fourmile Lake is stocked annually with brook trout, rainbow trout, and kokanee by the Oregon Department of Fish and Wildlife (ODFW) (Smith, pers. comm). Gill netting surveys have been conducted by ODFW for the past 40 years. No native fish species have been sampled during gill net surveys. Most lakes, after introduction of exotic species, usually have at least a remnant native fish population present, as exhibited in Upper Klamath, Odell, and Crescent Lakes. This indicates that Fourmile Lake was historically fishless. Currently, the Lake provides a popular recreational fishery. Gill net surveys indicate that kokanee and brook trout are reproducing in the lake.

Surveys for amphibians were recently conducted on the District for the first time. Amphibians known to occur in the area are the Pacific chorus frog, Cascade frog, western toad, rough-skinned newt, and the long-toed salamander.

4. Terrestrial Species

The watershed contains a variety of habitat types which support a diversity of wildlife species. Different plant communities each support specialist species, as well as generalist species which occur throughout the watershed.

Water sources are abundant in the western half of the watershed, but are scarce on the south and west-facing slopes of Pelican Butte. One wildlife water development has been built on the slopes of Pelican Butte.

Fire suppression has improved habitat in some areas for species such as spotted owls, which prefer dense canopies and multi-storied stands. Past logging and fire suppression have reduced habitat for species which prefer more open

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canopies or require large ponderosa pine and Douglas-fir for nesting and roosting, such as the bald eagle. The existing forest condition is unstable in some areas, particularly in low elevation stands (see Issue A).

Several meadows in the watershed provide foraging habitat for great gray owls (Forest Plan protection buffer species), sandhill cranes (Regional Forester Sensitive Species), and big game.

Rocky areas (i.e., talus, lava flows) occur throughout the watershed and are abundant on the slopes of Pelican Butte. Rocky areas provide habitat for many small mammals and birds, and possibly for bats and large predatory mammals. Forest Plan standards and guidelines require 200' protection zones adjacent to rock habitat which is being used for nesting, denning, or rearing by wildlife.

Species of woodpeckers, including the black-backed woodpecker and white-headed woodpecker (both Forest Plan matrix protection buffer species), occur in the North Fourmile area. Snags are likely to be abundant in lodgepole pine stands and riparian reserves, as well as unharvested or minimally logged areas.

Habitat exists for neotropical migratory birds such as flammulated owls (matrix protection buffer species), which are likely to occur, but have not been sighted in the watershed. Non-migratory passerines such as the pygmy nuthatch (matrix protection buffer species) occur on the District and are also likely to be in the watershed area.

Species which may have been present in the past but are now extirpated from this area include, grizzly bear, wolf, and lynx. It is likely that wolverines (Regional Forester Sensitive Species) are now also locally extinct. However, fisher (Regional Forester Sensitive species) may still occur in the North Fourmile area.

III. ISSUES AND KEY QUESTIONS

Issues were developed based on the Watershed Analysis Team's own knowledge, interviews with others interested or knowledgeable about the area (see Appendix A for a list of those contacted), and core questions listed in the watershed guide. Issues were used as main topics about watershed resources and processes, to be addressed during the analysis. Key questions were used to further focus the main topics.

The Klamath River Basin analysis was not completed prior to this analysis. The issues likely to come out of the basin analysis which pertain to the North Fourmile Watershed are described in the River Basin Context section. River basin concerns were incorporated into issues identified for the watershed area, where appropriate.

ISSUES

A. The pre-management forest structure, composition, and landscape pattern have been altered by management activities.

> How have disturbance processes and stand conditions changed in the different forest zones?

Are high levels of mortality caused by insects and disease occurring?

Is fire hazard high?

B.Long-term maintenance of habitat for sensitive plant species is a concern in some areas of the North Fourmile Watershed.

What are the suitable habitat characteristics for sensitive plant species at risk?

What are the risks to maintaining those characteristics?

How should sensitive plant habitat be managed?

C.Upland habitat for wildlife species has been altered by past management.

How has habitat been changed?

What is the current condition of the LSR and NRF (nesting/roosting/foraging) Habitat?

What is the current condition of low elevation white fir habitat?

D. Erosional processes have been altered.

How do current erosional processes compare with historic processes?

Have erosional processes, or the frequency and magnitude of these processes, changed over time? If so, by what mechanisms?

E.Management activities have changed the yearly flow patterns or hydrograph in the watershed.

Have historic flow patterns been altered; if so, what was the mechanism that caused the alteration?

How have flow patterns changed?

F.Stream channel condition has been altered.

What was the historic condition of stream channels in the North Fourmile watershed, and how does this compare with the current condition?

Have stream channels been altered, and if so, how?

G.Degradation of fish habitat has resulted in a reduction of the abundance and distribution of fish species in the watershed.

How have habitat conditions for fish changed?

What is the current condition of fish habitat?

What species no longer utilize the watershed because of habitat degradation?

H.Native fish populations are nearly extirpated.

How has the introduction of non-native species impacted native fish distribution?

I.Planning teams need additional guidance on how to manage riparian reserves in the watershed.

Where are riparian reserves located?

How does the current condition and functioning of riparian reserves compare to the reference condition?

What species use riparian habitats?

What types of management activities would benefit riparian reserve functioning?

J.The North Fourmile Watershed area contains a large concentration of historical sites resulting from past railroad logging. These sites need to be addressed during project planning and implementation.

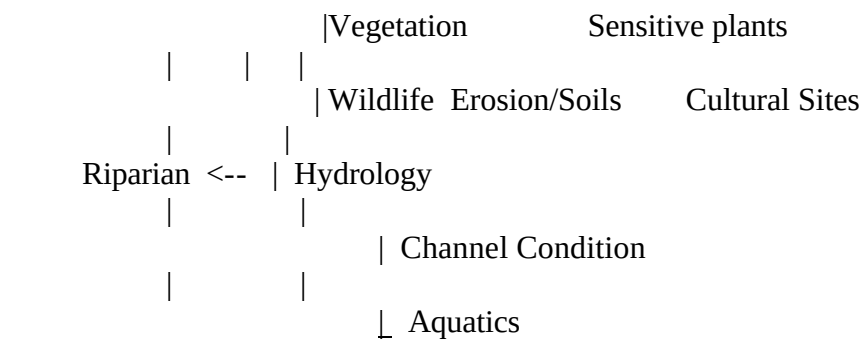
What is the significance of the sites?

What is the current condition of the sites?

How should the sites be managed?

ANALYSIS PROCESS

Issues are organized sequentially, such that information contained in the preceding issue is used in analysis of the following issue. Issues start with vegetation and upland concerns, progress to the aquatic zone, and culminate in a discussion of riparian reserve management. Other issues of importance in this watershed address sensitive plant and cultural resource concerns.



A. Issue: The pre-management forest structure, composition, and landscape pattern have been altered by management activities.

Key Questions: How have disturbance processes and stand condition changed in the different forest zones?

Are high levels of mortality caused by insects and disease occurring?

Is fire hazard high?

Conclusions:

Whitebark Pine Zone: Disturbance processes and stand condition have changed little in the whitebark pine zone. White pine blister rust has been introduced to the populations, but does not appear to be threatening viability. Mortality and fuel accumulations are low.

Mountain Hemlock Zone: Disturbance processes have not been significantly altered. For the most part, stand condition has changed little since 1940, except for natural succession of areas burned in the past. Most of this zone is located in wilderness or semi-primitive recreation management, and logging and fuelwood cutting have occurred over only a small percent of the area. Currently the time since fire suppression began is not outside the historic range for fire return intervals. Mortality from insects and disease are thought to be at levels similar to the past. Fuel loads are generally low to moderate.

Shasta Red Fir Zone: Fire suppression has probably altered disturbance processes in some areas of this zone, although at higher elevations and in drainages the time since fire suppression began is probably not outside the historic range of fire return intervals. Stand condition has changed as follows: natural succession has proceeded in areas burned by past fires; lodgepole pine is declining; canopy closure has increased as a result of succession and the absence of fire; late seral stands have declined slightly, as a result of logging; and logging has reduced the number of large pine and Douglas-fir trees in the lower elevations of the zone. Currently, mortality caused by insects and disease remains low and fuel loads are low to moderate. However, many stands are overstocked for the site potential. In overstocked stands, remaining large ponderosa pine are likely to die in the near future, and fir engraver outbreaks may occur in white fir at the lower elevations of the zone.

White Fir Zone: The historic fire regime, characterized by frequent low intensity fires, has been greatly altered by fire suppression. Stand condition has changed as follows: stand density has increased in the absence of fire (this has been partially offset by logging); logging has removed large pine and Douglas-fir from stands; logging and fire suppression have increased the percent of white fir in stands; logging has reduced the amount of late seral habitat. Large scale mortality from insects began in the 1980's in the Fourmile Creek subwatershed. This

contributed to high fuel loading and public safety concerns. Most of the affected stands have been recently thinned or are scheduled for harvest. In other areas of the white fir zone, high stocking levels are not currently causing high rates of mortality, but are likely to create forest health problems in the near future.

Discussion:

For the purposes of this analysis, 1940 was used as the historical reference point. This is the date of the earliest aerial photos of the watershed. Information prior to 1940 consists of only broad-scale verbal descriptions and maps. This information was incorporated where applicable.

1. White Bark Pine Zone

a. Disturbance processes

Lightning fires were probably the primary disturbance in these forests. Agee (1993) suggests that white bark pine forests may have fire regimes characterized by low intensity fires with moderate return intervals (50-100 years). Although a large number of lightning strikes occur on the peaks where whitebark pine grows, the sparse forests have little ground fuel. The lack of fuel and rockiness of the sites make it unlikely that past fires were very hot or extensive, or will be in the future. Rock slides may also create disturbance, particularly on Mt. McLoughlin.

b. Reference/current condition and management effects

A comparison of aerial photos from 1940 to 1992 shows little change in the white bark pine forests. White pine blister rust was introduced to the area prior to 1940 and is currently present in the populations. However, the disease does not appear to be causing large-scale mortality, as in some of the Rocky Mountain populations, and whitebark pine regeneration is occurring. Loss of whitebark pine forests in the watershed does not appear to be an issue at this time.

2. Mountain Hemlock Zone

a. Disturbance Processes

Past large stand-replacing fires appear to be the primary natural disturbance which shaped forests in this zone. Fire return intervals are estimated to have been long (200-500 years). Fire data from 1961 to 1994 show a rate of .037 lightning starts per square mile per year in this zone. For the most part, the starts appear to be randomly distributed, except for a tendency to be located on the upper slopes. Although all of the starts were extinguished, it is likely that, except in the driest years, most would have gone out on their own before reaching any size. Prior to the 1800's, Native Americans may also have set fires or allowed them to escape into this zone.

Insects and disease modify stands on a smaller scale. Pine beetles frequently attack lodgepole pine stands when they reach maturity (80-100 years). Root rot - Armillaria in Shasta red fir and Philinus in mountain hemlock - is locally active, particularly on rocky sites. Mistletoe is currently causing mortality of mountain hemlock in some areas of Sky Lakes Wilderness, and may have been a minor agent of disturbance in the past, as well.

Following large disturbance, lodgepole pine generally colonizes the basins, since mountain hemlock is slower to reproduce and Shasta red fir is limited by frost until an overstory is established. On the slopes, mixes of mountain hemlock, Shasta red fir, and lodgepole pine appear to slowly seed in.

b. Reference Condition

Aerial photos indicate that little timber harvest occurred in these upper elevation forests prior to 1940. At that time, less than 40% of the zone is estimated to have been in a late seral condition. (Late seral here is being defined as stands with >40% canopy closure which are either dominated by medium to large-sized trees or are dominated by small-sized trees but have at least 30% canopy closure from medium to large-sized trees. Some stands may be very old but not have late seral structure due to poor site conditions.) Continuous late seral stands of mountain hemlock/Shasta red fir were present on the western slopes of Pelican Butte, west of Big Meadows, and between Fourmile Lake and Lost Peak.

Fires which occurred before the turn of the century burned in the Lost Creek subwatershed, creating seral lodgepole pine stands in the low areas and young (seedling, sapling, pole) mountain hemlock/Shasta red fir stands on Lost Peak and the unnamed peak to the south. Early fires also burned around Fourmile Lake, with a similar effect. Lodgepole pine-dominated stands are estimated to have covered approximately 20% of the zone in 1940. Leiberg (1900) speculated that the fires were caused by travelers passing through the area on the wagon road between Jacksonville and Fort Klamath. Burns (1911) notes that the hunting season occurred during August, which encouraged use of the woods at the driest time of year, and increased the number of human-caused fires.

Insect and disease-caused mortality was locally apparent in some areas of the watershed in 1940. What appear to be 100-200 acre root rot pockets are visible on 1940/1950 photos in the upper Lost Creek drainage west of Big Meadows and at the northern tip of the Cold Springs Watershed. It is likely that other stands were affected by root rot at a smaller scale. Stands of lodgepole pine killed by pine beetles were not evident at that time.

c. Current condition and management effects

Seral stages

Since 1940, the amount of late seral habitat has decreased only slightly. Less than 10% of the zone has been harvested, and only 1% clearcut or shelterwood cut. PMR (Pacific Meridian Resources) data from 1988 suggests roughly 30% of the zone is currently in a late seral condition. Stands in Sky Lakes Wilderness and on the slopes of Pelican Butte have changed little. Timber was harvested from stands west of Big Meadows, creating early and mid seral patches, but not interrupting the connectivity of the forests. Most of this area is still suitable spotted owl nesting, roosting, and foraging habitat.

Canopy closure

Burned stands around Fourmile Lake, on Lost Peak, and in the Cold Springs Basin have filled in with trees, decreasing the amount of natural openings. However, new openings were created in the Cold Springs Basin. In the 1970's many of the lodgepole stands had become old enough to be susceptible to pine beetle attack and mortality was occurring. Firewood cutters subsequently removed overstory

lodgepole pine easily accessed from the major roads. Overall, canopy closure has increased in this zone since 1940, with most stands having canopy closure greater than 40%.

Species composition

Although lodgepole reproduction remains heavy in the wetter areas, mountain hemlock and Shasta red fir understories are coming in under the lodgepole in many stands and an overall reduction in lodgepole pine has occurred. It is likely this trend will continue without management to regenerate lodgepole.

Insects/disease/fire hazard

Pine beetle and other insect and disease caused mortality is currently at low to moderate levels. Fuel loads are generally low. In some of the remaining uncut lodgepole stands in the Cold Springs Basin, jackstraw fuels are accumulating. These stands are not a significant fire hazard at this time, however, because of the cold, wet climate of the basin and the discontinuity of the fuels. Forest health concerns do not appear to be an issue in this zone at present. Thinnings could be used to lessen future risk of pine beetle mortality in lodgepole, as discussed under Issue B.

3. Shasta red fir

a. Disturbance Processes

Both stand-replacing and underburn fires likely occurred in this zone, and were probably variable in size. Estimated fire return intervals on the mid slopes are 40-80 years. Intervals were probably longer in the bottoms of the drainages and near the overlap with the mountain hemlock zone. Fire data indicate an occurrence of .035 fire starts per square mile per year in the Shasta red fir zone between 1961 and 1994, slightly fewer than in the mountain hemlock zone. The majority of these occurred on the slopes of Pelican Butte. The effect of Native American burning in this zone is unknown; however, fires which were started in the white fir zone may have extended into the Shasta red fir zone.

Insects and disease generally operate at the stand level. Pine beetles attack mature lodgepole stands at upper elevations and individual ponderosa pine at the lower elevations. Armillaria root rot creates pockets of dead Shasta red fir and white fir. Fir engraver beetles are active primarily in white fir at the lower elevations of the zone.

Lodgepole pine first colonizes disturbed areas susceptible to frost, forming a protective overstory for Shasta red fir regeneration. Dense fir regeneration is common on disturbed sites on the upper slopes. Brush generally occupies disturbed sites on rocky slopes and at lower elevations. Underburn fires probably thinned stands, removing small trees, while large fire resistant trees remained. Underburns probably also promoted growth of ponderosa pine and Douglas-fir in the lower range of the zone.

b. Reference Condition

By 1940, a small amount (est. 10%) of the Shasta red fir zone had already been logged. Logging up the Lost Creek drainage and on the southern slopes of Pelican Butte occurred early in the century. Primarily large ponderosa pine

were removed during these operations. The intent was to regenerate pine and/or Douglas-fir in the logged stands; however, many of the units still had a fairly high canopy closure of medium to large-sized true fir after logging.

More important in shaping the forests were the fires mentioned in the mountain hemlock section above, which burned on Lost Peak, on the unnamed peak to the south of Lost Peak, and up the Lost Creek/Cold Springs drainage. These created a mosaic of open seed/sap/pole stands, surviving late seral patches, brush, and lodgepole pine stands in the drainages. As a result, lodgepole pine is estimated to have occurred over approximately 25% of the zone in 1940, and less than 50% of the zone is estimated to have been in a late seral condition.

Insect and disease caused mortality was not evident on 1940 or 1950's photos in the Shasta red fir zone. It is likely insects and disease were active at endemic levels.

c. Current condition and management effects

Seral stages

Approximately 2,700 acres have been logged. However, PMR data indicate that approximately 40% of the Shasta red fir zone has been retained in a late seral condition. Late seral forests are relatively continuously distributed on the mid slopes of Pelican Butte, in the Horse Creek drainage, and in the upper Fourmile drainage. Late seral habitat is largely absent from the Lost Creek drainage/Cold Springs basin, the result of past fires.

Canopy closure

Canopy closure in the Shasta red fir zone is high, and has probably increased overall since 1940. More than half of the zone has closure greater than 55%, and two thirds of the zone greater than 40%. Previously intensely burned stands have filled in since 1940. Lack of underburn fires in the lower elevations may also have allowed stands to develop denser understories. As described in the mountain hemlock section above, lodgepole pine stands in the Cold Springs basin died from pine beetles and were harvested for firewood. These stands comprise most of the current openings in the zone.

Species composition

Species diversity has decreased in this zone since the early 1900's. Similar to the mountain hemlock zone, seral lodgepole pine is being succeeded by Shasta red fir in the Cold Springs basin and mid portions of the Lost Creek drainage. The decline of lodgepole will continue without management. At the lower end of the zone, the ponderosa pine and Douglas-fir component has decreased, and stands have higher percentages of Shasta red fir and white fir than occurred prior to management. Selective logging and alteration of the fire regime contributed to this change. Without fire, regeneration of ponderosa pine and Douglas-fir has declined, and competition from dense fir understories has increased mortality, especially of ponderosa pine, as described below.

Insects/disease/fire hazard

Armillaria root rot is present in small pockets, primarily on the rocky southwest slope of Pelican Butte. These pockets are likely to slowly expand over time. Fir engraver beetles are active in white fir at the lower

elevations of the zone. Mortality remains low at present, but a prolonged period of drought could trigger increased loss to fir engraver. Pine beetles are attacking large residual ponderosa pine in stands that are stocked at greater than 140 square feet basal area. The ponderosa pine trees are likely to die within the next 5-10 years without treatments to reduce density and competition, further reducing species diversity. Pine beetle activity in lodgepole pine is currently at low levels. Fuel loads and fire hazard are generally low to moderate in this zone. Currently, forest health problems are not a major concern in this zone. However, initiating density treatments now would prevent loss of large ponderosa pine, and lower the risk of future insect mortality in lodgepole pine stands and white fir at the lower elevations of the zone.

4. White fir zone

a. Disturbance Processes

Stands on the flats and lower slopes are thought to have been shaped by frequent (10-40 year average return interval) low intensity fires which removed fire-intolerant young white fir and favored ponderosa pine and Douglas-fir. Small patches of intense stand-replacing fires also occurred. Fire return intervals may have been longer in the bottom of the drainages. Between 1961 and 1994, fires occurred at a rate of .029 lightning starts per square mile per year in this zone, with most occurring in a band along the lower slope of Pelican Butte.

The rate of human-caused fire starts since 1961 in this zone is more than double the rate of lightning starts, and is one of the highest rates on the District. This may have been true in the past. Leiberg (1900) and Burns (1911) speak to the large number of fires caused by Euroamerican settlers and travelers. With the concentration of people in the Rocky Point area, fires no doubt occurred. Prior to arrival of Euroamericans, Native Americans were known to use the lower Fourmile area. Although information on the use of fire by Klamath people is lacking, based on studies of other tribes, they may have employed fire for a variety of uses, such as improving habitat for game, hunting game, promoting growth of food plants, and harvesting plants. Escaped fires may also have occurred.

Historic accounts describe flooding and ponding in the lower reaches of Fourmile Creek. Seasonal inundation helped shaped the forests and meadows in this area. A few feet difference in elevation promoted growth of different vegetation types: meadows formed in the low lying areas where water ponded; aspen grew along the channels and meadow edges; ponderosa pine became established on the small rises; and lodgepole pine occupied intermediate sites.

Insects generally operate at the stand level in the white fir zone, but may reach epidemic proportions. Fir engraver beetles are active in white fir; stands stressed by high stocking levels, prolonged drought and Armillaria root rot are most susceptible. Pine beetles attack ponderosa pine and mature lodgepole, particularly in heavily stocked stands. Armillaria root rot creates pockets of dead white fir.

b. Reference Conditions

Burns (1911) refers to a yellow pine type occupying the east side of the Cascade Forest Reserve up to approximately 5,000' elevation, corresponding to

the white fir zone. He describes it as not being pure, but nearly so, especially on the slopes, benches, and flats. Douglas-fir, sugar pine, and white fir were usually present. According to Burns, the yellow pine type was comparatively open and the forest floor was dry, although in places, there was a heavy cover of snowbrush and other shrubs. Leiberg (1900) also notes the large amount of ponderosa pine in the area and lists the composition of the forest in Township 36S Range 6E as being: 40% ponderosa pine; 20% Douglas-fir; 20% lodgepole pine (in the low-lying areas); 18% white fir; 1% incense cedar; and 1% sugar pine.

The white fir zone in the watershed area was logged early in the century because of the extent and value of the ponderosa pine. Roughly 6,000 acres had been logged by 1950, including the south slope of Pelican Butte, the Fourmile Flat-Rocky Point area, and the lower Lost Creek drainage. Records indicate an average of 25 MBF of ponderosa pine per acre was removed during logging.

At the time of the first sale in 1910, foresters were trying to reduce invasion of white fir and regenerate ponderosa pine and sugar pine. Prescriptions were intended to leave sufficient ponderosa pine and sugar pine seed trees and remove white fir. The soil would be "stirred" by logging and fire would be used to remove brush and create a seed bed for pine.

Aerial photos from 1940 show that >40% canopy closure was left in many of the logged stands and white fir regeneration was starting to form dense understories in some areas. Open disturbed sites totaled approximately 2,000 acres and contained brush and/or white fir regeneration. Some of the disturbed areas were a result of past fire, or fire followed by logging, particularly in the lower Lost Creek Drainage and in small patches on the lower slope of Pelican Butte. Stands in the western most part of the white fir zone had not been logged by 1940. These stands probably originally contained a higher proportion of white fir and Douglas-fir. Overall, an estimated 60-70% of the zone was in a late seral condition in 1940. Prior to logging, it may have been higher than that.

The early timber sales were also used to remove dead, diseased, and overmature trees. Bark beetles were targeted for control by cutting down infected pine. In a sample stand in the sale area, 10% of the mature pine was infected by bark beetles. Burns (1911) noted that white fir was susceptible to decay, and trees >40" in diameter were too rotten to use.

c. Current Condition/Management Effects

Seral stage

Since 1940, logging has occurred over 6,000 acres of the white fir zone. Several stands were logged more than once. Almost 90% of the treatments were thinnings or partial removals, rather than regeneration cuts. The amount of late seral habitat has declined significantly as a result of the logging; PMR data suggests that only 20% of the zone is currently in a late seral condition. Distribution of late seral habitat is patchy.

Canopy closure

It is unclear how canopy cover has changed since 1940. Logging has thinned stands and created new openings. However, some stands which were open and disturbed in 1940 have since filled in. Prolonged lack of underburn fires has

also allowed development of white fir understories in stands which were once more open. Currently, about 65% of the zone has canopy closure greater than 40%, and 27% of the zone has canopy closure greater than 70%. Stand densities exceed site potentials in some areas.

Species composition

The amount of ponderosa pine and Douglas-fir present in the zone has been reduced through selective logging and lack of fire, as described under the Shasta red fir section above. The percentage of white fir has increased in many stands. Lodgepole pine has approximately the same distribution as in 1940, occurring in the Fourmile Flat and Rocky Point areas.

Insects/disease/fire hazard

A large amount of mortality resulting from high stocking levels and drought began in the lower Fourmile drainage in the late 1980's. Pine beetles were killing heavily stocked lodgepole stands and attacking large remnant ponderosa pine in mixed conifer stands. Fir engraver beetles were killing densely stocked white fir.

The mortality resulted in high fuel loads and a concern for the safety of people living in the area. Loss of large trees in designated bald eagle habitat was also a concern. Several timber sales in and near the Fourmile Flat and Rocky Point areas were conducted to treat these problems. As a result, insect and fire hazard concerns have been lowered. Remaining overstocked NFS stands in the Rocky Point area are currently being planned for treatment as part of the proposed Bugsy Salvage project.

Mortality may continue to occur in the Rocky Point and Fourmile Flat areas, although probably at lower levels than prior to treatment. Not all private lands have been managed to reduce fuels and stocking levels. Future treatments may be necessary on NFS lands, and there may be an ongoing need to remove individual hazard trees. The District is proposing to develop a plan to manage forests in this area, but this work was not funded in 1996.

In other parts of the white fir zone, ponderosa pine are also at risk of pine beetle attack due to stress from high stocking levels. Mortality from fir engraver beetle and armillaria root rot is currently at low to moderate levels. Fire hazard is moderate to low. Initiating thinning treatments at this time in stands where stocking levels exceed site potential could reduce loss of large ponderosa pine and lower the risk of future insect and fuel problems.

5. Management Recommendations

The District already has in place a process for assessing insect, disease, and fire risk and developing silvicultural treatments.

B. Issue: Long-term maintenance of habitat for sensitive plant species is a concern in some areas of the North Fourmile Watershed.

Key Questions: What are the suitable habitat characteristics for sensitive plant species at risk?

What are the risks to maintaining those characteristics?

How should sensitive plant habitat be managed?

Conclusions:

Four sensitive plant species may be affected by future management activities: collomia occupies forested habitats in the Lost Creek subwatershed; red root yampa and sticky catchfly occur in the meadow near Pelican barn; pygmy monkeyflower occurs in the channelized portion of Fourmile Creek near Pelican Barn. Collomia may be impacted by future timber harvest, the other three species may be impacted by restoration of lower Fourmile Creek. Silvicultural and prescribed fire treatments and mitigations are recommended for collomia. Analysis considerations are recommended for the other species.

Discussion:

Four sensitive plant species have habitats which may be affected by future management activities in the watershed. Very little is known about the species' historic distribution and abundance.

1. Reference Condition/Habitat Characteristics

a. Mt. Mazama Collomia

The distribution and abundance of collomia in the Cold Springs basin prior to 1991 is unknown. A comparison of the current distribution and abundance of collomia was made with habitat conditions in 1940, as indicated by aerial photos. Many of the areas where collomia is currently concentrated were heavily burned prior to 1940. Some stands were still open with less than 40% canopy closure, other areas consisted of young lodgepole pine stands with 56-70% canopy closure. Partially burned mature Shasta red fir stands with clumps of seed/sap/pole trees also were present in currently occupied areas.

Observation and stand exam data suggest the following characteristics are components of suitable collomia habitat in the Cold Springs basin:

Seral lodgepole pine stands resulting from past stand-replacing fire.

Climax mature Shasta red fir-mountain hemlock stands, burned by low to moderate intensity fire in the past.

Forest-meadow ecotones resulting from past fire and edaphic features.

Variable canopy closure. The species does not do well in heavily harvested stands, and seedling survival has been shown to increase with stand basal area. However, there appears to be an upper limit to preferred canopy closure. Edges and gaps are thought to be important to the species.

Glacial till and volcanic soils with a minimal duff layer. Removal of duff may be important for recruitment. Although collomia occupies areas subjected to past ground disturbance (e.g., skid trails) it is not known whether this is a favorable condition.

Collomia was collected in the Horse Creek drainage by E. Applegate in 1925. There is no information on the population size at that time. Habitat conditions of the Horse Creek drainage in 1940 appear to be similar to those currently present.

b. Pygmy Monkeyflower

By 1950, the date of the District's earliest aerial photos of the Pelican Barn meadow, Fourmile Creek had already been channelized. Pygmy monkeyflower may have been present along the banks of the channel at that time, as it is found today. It is unknown whether the species inhabited natural intermittent waterways in the area, or whether it became established after channelization. The species does occur along intermittent creeks on the Rogue River National Forest to the west, and on the Chiloquin Ranger District to the east.

c. Red Root Yampa and Sticky Catchfly

Red root yampa was first identified at the Pelican Barn meadow by Area IV Ecologist Bill Hopkins in the 1970's. Prior to that time, there is no information about the population. Sticky catchfly was located at Pelican Barn in 1991. Both species currently occupy sites around the edge of the Pelican Barn meadow; it is likely that historically, these species occurred in similar sites. Channelization of Fourmile Creek and changes in the hydrology of the meadow may have had some effect on the populations. Changes in the fire cycle may also have been important.

2. Current Condition and Management Effects

a. Mt. Mazama Collomia

The Cold Springs population was found to contain important genetic variation within the range of the species (Baldwin, in progress). Genetic analysis indicates the Cold Springs population is distinct from larger and more stable populations in Crater Lake National Park, on the Rogue River National Forest, and in the Cherry Creek drainage on the District. Instead, it is more closely allied with populations at risk on the Rogue River National Forest.

Approximately a third of the collomia habitat in the Cold Springs basin consists of seral lodgepole stands. Some of these stands were heavily cut by firewood cutters and now have very little canopy closure. Collomia still exists in these areas; however, monitoring data suggest reproduction is lower than in adjacent stands with more canopy closure. Uncut lodgepole stands are succeeding to Shasta red fir-mountain hemlock and are unstable over the long term. Mortality of the lodgepole from pine beetles is likely to occur within the next 20 years.

Past timber harvest west and northwest of Big Meadows has reduced canopy closure to less than 40% in some fir stands. Few plants are present in these open areas. It is not known whether these stands had more collomia prior to harvest.

Over a third of the collomia habitat in the Cold Springs basin lies in timber production and scenic management areas, which are scheduled for timber harvest. Without consideration for collomia, future impacts from timber harvest could be significant. Loss of large numbers of individuals is a concern; the plants are long-lived and the rate of establishment of new seedlings appears to be very low.

Recent surveys indicate the Horse Creek population is small (less than 50 individuals). The population lies within the wilderness boundary, and there appear to be no threats to its viability.

b. Pygmy Monkeyflower

The Pelican Barn site has been occupied consistently by pygmy monkeyflower since 1992, but populations fluctuate greatly from year to year in response to annual precipitation and timing of runoff. Because the species is an annual, the seed bank is key to maintaining population size and stability. Although the channel banks are eroding in some places, they appear to be relatively stable on sites occupied by pygmy monkeyflower. The population would probably persist indefinitely on the site without further management. Future attempts to restore the functioning of lower Fourmile Creek would likely impact the existing pygmy monkeyflower habitat, and could extirpate the species on the Klamath Ranger District.

c. Red Root Yampa and Sticky Catchfly

Difficulty in identifying red root yampa has led to a poor understanding of the current abundance and distribution of the species at Pelican Barn. However, it is thought to be very rare. Currently, the sticky catchfly population is estimated at 1,500 and appears to be stable. Both of these species could potentially be affected by future efforts to rehabilitate lower Fourmile Creek, if changes occur in the water table or duration of seasonal flooding.

3. Management Recommendations

a. Mt. Mazama Collomia

Management should consider the following treatments to maintain or enhance collomia habitat and the distribution of the species in the Cold Springs basin.

1) Thin mature lodgepole stands to retain existing habitat as long as possible, maintaining an overall canopy closure of 40% or greater.

2) Use small group selection cuts in areas not currently occupied by collomia to create edge habitat and regenerate lodgepole pine. Leave 15% canopy closure in the groups and underburn.

3)Maintain and/or speed development of mature Shasta red fir/mountain hemlock stands, with small gaps and partially open canopies. This may include thinning from below to a canopy closure of approximately 50%.

4) Experiment with prescribed fire where feasible to remove duff and understory vegetation.

5)Log over snow in currently occupied areas to prevent destruction of plants.

6)Monitor treatment units for effectiveness.

b. Pygmy Monkeyflower

The following should occur prior to initiating restoration of lower Fourmile Creek:

1)Determine whether the benefits of a restoration project justify the risk of extirpation of pygmy monkeyflower on the Klamath District.

2)Evaluate the importance of the pygmy monkeyflower population at Pelican Barn to the viability of the species as a whole.

3)Determine whether mitigation measures could be used to lower risk of extirpation at the site. Some examples might include collecting soil likely to contain seed prior to project implementation, and redistributing the soil following project completion.

c. Red Root Yampa and Sticky Catchfly

The following should occur prior to initiating restoration of lower Fourmile Creek:

1)Determine the current distribution, abundance, and habitat requirements of red root yampa.

2)Evaluate the potential for detrimental changes to the habitat of both species.

C. Issue:Upland habitat for wildlife species has been altered by past management.

Key Questions: How has habitat been changed?

What is the current condition of the LSR and NRF habitat?

What is the current condition of low elevation white fir habitat?

Conclusions:

Upland wildlife habitat has been changed by fire suppression and logging. This has reduced the number of big trees, particularly pine and Douglas-fir, and has allowed for development of multiple canopy layers. Overall, NRF habitat has probably increased during the past 50 years.

The LSR currently meets the recommendations of the LSR assessment; dispersal habitat is abundant, and NRF comprises more than 50% of the LSR. Connectivity within the watershed and to adjacent watersheds is good. Past timber harvest has reduced NRF on the south-southwest slope of Pelican Butte. Approximately 10% of the LSR is at risk of degradation from insects/disease in the near future.

Low elevation white fir habitats have been the most affected by past management. In these low elevation areas, bald eagle habitat overlaps with LSR.

Discussion:

1. LSR and NRF

LSR R0227 comprises 11,018 acres of the North Fourmile watershed. It primarily overlaps with the white fir zone, but also includes low elevation Shasta red fir forest. For this analysis, the amount, distribution, and condition of suitable spotted owl nesting, roosting, and foraging habitat (NRF) was used as a measure of desired habitat in the LSR, regardless of whether it falls into late seral or mid seral categories. Although bald eagle habitat occurs within the LSR, it will be discussed under the low elevation white fir section.

a. Reference Condition

Issue A details the reference condition of forests in the white fir and Shasta red fir zones in 1940. In general, although forest fires and logging had occurred, a majority of the stands currently located within the LSR boundaries were in a late seral condition in 1940. However, many stands did not provide NRF habitat. Multiple canopy layers and dense canopy closure were lacking in some of the harvested/burned stands, as well as in uncut stands at lower elevations and on dry aspects.

Large ponderosa pine were present in most stands. Uncut stands at lower elevations and on dry aspects were probably dominated by large diameter

ponderosa pine in 1940. Large Douglas-fir trees were abundant in riparian areas and in the southwestern portion of the LSR, where little harvest had occurred.

b. Current Condition/Management Effects

1) NRF and Dispersal Habitat

As described under Issue A, changes have occurred in the white fir zone and lower elevations of the Shasta red fir zone as a result of management activities. In some stands, fire suppression has improved habitat for late successional-associated species, such as the spotted owl, by allowing development of dense canopies and multiple canopy layers. Logging has partially offset this effect by reducing canopy closure in harvested units. Logging has also removed large diameter ponderosa pine and Douglas-fir trees suitable for nesting. Overall, it is probable that more NRF habitat exists today than in 1940.

Currently, acres meeting NRF habitat requirements within the watershed total 14,014, or roughly 40% of the watershed area. Approximately 44% of the NRF habitat (6,106 acres) is located within the LSR. The rest lies in wilderness (4,654 acres) and matrix (3,145). The LSR in the watershed is comprised of 55% NRF, slightly above the 50% minimum recommended in the LSR Assessment. Spotted owl dispersal habitat is abundant in the watershed. Stands meeting dispersal habitat requirements total 23,243 acres, or roughly 64% of the watershed. Within the LSR, 9,422 acres or 86% of the area is suitable dispersal habitat. Less than 25% of the LSR in the watershed exists as openings, which meets LSR Assessment recommendations. See Figures 12 and 13.

2) Connectivity

NRF habitat is "well distributed" in the watershed and connectivity is currently "very good". Many of the areas lacking in NRF (e.g. Mt. McLoughlin, Fourmile Lake, Cold Springs basin, Fourmile Flat/Rocky Point, top of Pelican Butte) result from natural features and conditions or historic fires, rather than past management. An area of concern within the LSR is located on the south-southwest slope of Pelican Butte in the Fourmile Creek and Lost Creek subwatersheds. Although dispersal habitat is still present, past timber harvest has narrowed the connection of NRF habitat between the northeast and southwest portions of the LSR. Dispersal habitat is limited and NRF is largely absent in matrix lands downslope of this area, because of past harvest. In the Pelican Butte semi-primitive area upslope of the LSR, connecting NRF habitat is still present.

Blocks of non-habitat present in the southcentral part of the watershed area, primarily in the Fourmile Creek above Seldom Creek subwatershed, also limit east-west dispersal in the LSR. However, adjacent wilderness does provide for additional habitat corridors between these areas. North-south dispersal habitat is present within the LSR and extends along the western edge of the Lost Creek subwatershed and adjacent wilderness.

An analysis of spotted owl habitat in a three-mile buffer around the North Fourmile watershed boundary was done to look at connectivity with adjacent watersheds. NRF habitat totals 15,982 acres in the three-mile buffer. NRF provides connectivity north and south to adjacent watersheds; continuing within LSR R0227 northeast around Pelican Butte to the Rock Creek watershed, and south

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to the Lake of the Woods basin. Likewise, dispersal habitat is plentiful in the three-mile buffer (28,469 acres). Spotted owl habitat is absent to the east because of the presence of Upper Klamath Lake. Information was not available for the Rogue River portion of the Sky Lakes Wilderness to the west.

3) Maintenance of Habitat in the LSR

Recent stand exam data indicate that at least 10% of the LSR is at risk of degradation from insect mortality over the next 10 years (data is not currently available for the Fourmile Creek above Seldom Creek subwatershed). It is expected that loss of remaining large pines will occur in stands totaling 626 acres. Loss of canopy closure due to fir engraver mortality is likely to occur over 394 acres. Of particular concern is degradation of NRF habitat on the south-southwest slope of Pelican Butte where such habitat is already limited.

4) Late Successional-Associated Species

Appendix C lists data for spotted owls in the LSR and watershed as a whole. As of 1995, 7 pairs and 1 territorial single have been located within the watershed, 5 of which occur within the LSR. This comprises 14% of the known spotted owls on the Klamath Ranger District. Five activity centers adjacent to the watershed have territories which overlap with the watershed boundary.

Other late successional-associated species likely to occur within the LSR include northern goshawk, bats, Pacific fisher, American marten, and some species of neotropical migratory birds. See Appendix C.

c. Recommendations

1)Maintain existing NRF and speed development of future NRF habitat on the south-southwest slope of Pelican Butte within the LSR.

2)Maintain the current connectivity of NRF habitat within the LSR and between the North Fourmile watershed and adjacent watersheds.

2. Low Elevation White Fir Habitat

a. Reference Condition

This habitat is located primarily in the lower elevations of the Fourmile Creek subwatershed, including the Fourmile Flat/Rocky Point area and lower south-facing slopes of Pelican Butte, but also includes the lower portions of the Fourmile Creek above Seldom Creek and Lost Creek subwatersheds. In these areas, frequent low intensity fires created and maintained open-canopied stands of mixed conifer with a significant amount of ponderosa pine, sugar pine, and Douglas-fir trees. These stands provided nesting and roosting habitat for many of the matrix protection buffer species, and within close proximity to Upper Klamath Lake, provided habitat for bald eagles.

b. Current Condition/Management Effects

As described under Issue A, logging in the white fir zone removed many of the large diameter ponderosa pine and Douglas-fir, reducing the number of nesting and roosting trees.

incidence of tree mortality from

disease and insect infestation. Of particular concern is the continuing loss of large pine trees from pine beetle infestation. Fire suppression has also limited the amount of pine regeneration.

1) Matrix Protection Buffer Species

Pygmy nuthatches, flammulated owls, black-backed woodpeckers, and possibly white-headed woodpeckers are likely to occur in the watershed. These species require snags, and favor large pine snags greater than 20" in diameter, which occur most frequently in low elevation white fir stands. (Black-backed woodpeckers also forage in stands of recently dead lodgepole pine, which occur in upper elevation forest zones as well.) Currently, snag levels are above recommended levels in the Forest Plan in most low elevation stands. However, the lack of large pines for future snag recruitment is a concern.

2) Bald Eagle Habitat

A total of 825 acres of bald eagle management area are present in the Fourmile Creek subwatershed. Of this, 214 acres are bald eagle nesting habitat (Management Area 9A) and the remainder, replacement habitat (Management Area 9B). All of the nesting habitat and 549 acres of the replacement habitat are in LSR R0227.

Approximately 287 acres of bald eagle habitat have been logged since the early 1980's. Of the 287 acres, 215 acres have been treated twice during this time period. Presently, most of the bald eagle management area is considered to be in a relatively stable condition.

All of the eagle habitat in LSR and approximately half of the eagle habitat in matrix is also suitable spotted owl dispersal and NRF habitat. Relatively "good" continuous owl habitat exists outside of eagle management areas, and the treatment of eagle habitat has not disrupted the connectivity of LSR R0227.

Two bald eagle nest sites/territories have been identified within the watershed. These two territories comprise 14% of all known bald eagle territories on the Klamath District. See Appendix C for more information.

c. Recommendations

1) During management activities retain all large pine and Douglas-fir snags where feasible. Manage stands to grow large recruitment trees.

2) Where conflict exists between management for bald eagle and spotted owl habitat in LSR, the following should be considered:

The health and status of the bald eagle population in the Klamath Basin and in the state of Oregon compared to the health and status of spotted owl populations on the District and in the Pacific Northwest.

The availability of spotted owl habitat corridors between the North Fourmile watershed and adjacent watersheds.

The sustainability of spotted owl habitat in bald eagle management areas.

D. Issue:Erosional processes have been altered.

Key Questions: How do current erosional processes compare with historic processes?

Have erosional processes, or the frequency and magnitude of these processes changed over time? If so, by what mechanisms?

Conclusions:

Surface erosion has remained the dominant erosional process in the watershed. Landslides and debris flows are infrequent. Changes in the frequency and magnitude of erosional processes have increased as a result of detrimental soil compaction caused by timber harvest and road construction. Soil compaction and vegetation removal have increased overland flow, accelerating erosional rates above historic levels. Of specific concern are roads in close proximity to streams. These roads have the greatest potential for increasing sediment loading in the streams and causing changes in channel morphology. Recommendations include road closures and road maintenance, soil protection measures, and sub-soiling compacted areas.

Discussion:

1. Reference Condition/Background Information

Surface erosion was the predominant erosional process in the watershed. The potential for surface erosion was directly related to the slope gradient, soil type, rock content, and amount of bare soil exposed to rainfall and runoff.

Slope influences the occurrence, rate, and intensity of erosional processes. For example, the carrying capacity of water increases very rapidly with an increase in velocity, and the velocity of flowing surface water is dependent on slope. Therefore, the greater the slope, the higher the probability for erosion to occur, and the larger the magnitude of the event. Slopes in the watershed are generally less than 35%. Steeper slopes are associated with the major peaks and also occur in sections along Lost Creek and Upper Fourmile Creek.

Soil type or soil texture plays a key role in determining the magnitude of an erosional event. Soils which contain higher percentages of fines, silts, and clays will be more susceptible to detachment and transportation. Rock content of the soil influences the occurrence of surface flows. Soils with higher rock content have higher infiltration rates. Soils with lower rock content and lower infiltration rates have greater potential for surface flows. Both 'X' and 'R' soils in the watershed often have a high rock content. As an indicator of this, over 14,000 acres in the watershed outside of wilderness are currently mapped as being too rocky for timber production. Landtypes associated with meadows and the floodplain of lower Fourmile Creek have soils with finer texture.

Vegetation acts as a buffer, protecting the soil surface from rain. In areas devoid of vegetative ground cover, erosional processes begin when raindrops

strike bare soil peds and clods, causing finer particles to move with the flowing water as suspended sediments. Prior to management, the occurrence of erosion was influenced by the frequency and intensity of fires which removed protective ground cover. The greater the fire intensity, the greater the potential for increased erosion. Stand-replacing fires may also have resulted in scorched, unfertile bare soils in some areas. These areas would have been susceptible to erosion until revegetation occurred.

Landslides and debris flows are not common in the watershed, primarily because of low slope gradients and high rock content, which allows for rapid infiltration.

2. Current Condition/Management Effects

Changes in the frequency and magnitude of erosion in the watershed have resulted from fire suppression and creation of compacted surfaces through road building and timber harvest.

In the short term, the suppression of natural fires has reduced erosion resulting from stand replacement fires. However, in the long term, accumulation of fuels will increase potential for stand-replacing events.

Compaction, resulting from timber harvest and road construction, has affected the potential for surface erosional processes. Compaction slows infiltration rates, promoting surface water flow, which in turn promotes initiation of erosional processes. Over 5,000 acres have been compacted as a result of timber harvest (4,400 acres), road construction (600 acres), and channelization activities (20 acres). Past harvest units generally exceed Forest Plan standard and guidelines, which state that no more than 20 percent of an activity area can be detrimentally impacted.

An overall sensitivity rating was determined for each soil type, based on its susceptibility to impact and its resilience to long-term degradation (Figure 14). Soil porosity, the organic capital in surface litter, and surface soil horizons were analyzed to determine the susceptibility and resilience of soil types to compaction, erosion, and nutrient loss. Landtypes 1, 8, and 10 have a moderate to high sensitivity to land management activities because of their inherent unconsolidated structure. Other soil types in the 'R' and 'X' soil groups have moderate sensitivities to management activities.

Accelerated erosional processes in close proximity to streams (320') is of the greatest concern, because of the potential for deposition in the stream. Increasing sediment loading in streams can result in changes in channel morphology. Approximately two miles of Forest Road 3651 run parallel to Lost and Cold Creeks. Accelerated erosion has increased sedimentation rates in this area. Forest Roads 3454-170, 3454-190, 3454-220, 3458-230, 3458-330, 3458-400, 3651-290, and 3659-080 are also found within 320' of streams and have the potential to route sediment towards streams. Other forest roads contributing to erosion/sedimentation are included in the WIN inventory projects listed in Appendix D.

3. Management Recommendations

a. Unnecessary roads and roads difficult to maintain should be targeted for removal.

b. Roads within 320' of streams should be removed where feasible. Roads that are retained should be upgraded and maintained at the necessary standard in order to limit the transport of sediments.

c. Activities should be carefully planned on slopes greater than 35 percent and in areas with sensitive soils to avoid further accelerating erosional processes.

d. Soil moisture standards of 17% should be applied to all projects requiring use of heavy equipment in order to prevent additional detrimental compaction. Over-the-snow logging should be employed in areas where soil moisture standards cannot be achieved.

e. Sub-soiling should be used to rehabilitate compacted areas where feasible.

E. Issue: Management activities have changed the yearly flow patterns or hydrograph in the watershed.

Key Questions: Have historic flow patterns been altered; if so, what was the mechanism that caused the alteration?

How have flow patterns changed?

Conclusions:

Fourmile Creek originates at the mouth of Fourmile Lake. Historically, flows from Fourmile Lake maintained the upper reaches of Fourmile Creek as a perennial stream. Flow patterns in Fourmile Creek (the hydrograph) were altered by construction of a dam across the outlet of Fourmile Lake in 1890 which diverted water to the west side of the Cascades. Channelization of the last two miles of stream in the early 1900's also affected flows by increasing velocities and dropping the water table. The impact of these management activities has changed the timing of peak flows, and the duration and magnitude of base and bankfull flows. Fourmile Creek, once perennial in the upper reach, is now largely intermittent. Horse Creek has been unaltered by past management. Along with small springs, it provides flow to the remaining perennial sections of Fourmile Creek. The hydrographs of Lost Creek, Cold Springs Creek, and their tributaries have also remained unchanged, overall. Minor site-specific disturbances from woodcutters, timber harvest, and road construction have not altered their flow patterns.

Discussion:

1. Reference Condition/Flow Processes

Flows in the watershed were characterized by a snowmelt regime. The timing of peak flows, bankfull flows, and base flows were a function of snow pack and timing of spring melt. There is no historical information on flows before the 1900's and construction of Fourmile Dam. Assumptions were made based on geomorphological features and current functioning of similar watersheds.

The Fourmile Lake basin is located in a cold air pocket that remains under snow later in the season than the headwaters of many of the surrounding watersheds. Historically, Fourmile Lake acted as a catchment for waters leaching from the upper watershed area, most of which is located in Sky Lakes Wilderness. Late season snowmelt from the high elevations, along with the numerous springs surrounding the lake, sustained lake levels throughout the summer and fall months. Recharge of Fourmile Lake occurred rapidly and frequently during early winter storms that often consisted of rain. With rapid recharge of Fourmile Lake, lake levels were already high by the time of spring melt. As a result, peak flows in Fourmile Creek were not delayed, and usually occurred in late April and early May.

Historically, the upper section of Fourmile Creek in the Fourmile Creek above Seldom Creek subwatershed may have had perennial flow. Base flows in this upper section were a function of late snowmelt in high elevation areas,

numerous springs and tributaries surrounding Fourmile Lake, flows in Horse Creek, and springs located along the middle terraces of Fourmile Creek. These sources may have supported base flow in the upper section of Fourmile Creek through the late summer and fall months. Peak flow amounts, timing, and duration were directly related to the amount of snow pack and spring temperatures.

Horse Creek, the major tributary in the upper section of Fourmile Creek, also flowed perennially. Timing of peak flows and sustaining baseflows were regulated by late snowmelt and springs located along its entire length.

Lost Creek, Cold Springs Creek, and their tributaries were intermittent, with local perennial segments. Flow patterns were the product of snowmelt in the Cold Springs and Lost Creek basins. Perennial stream segments were fed by springs scattered along the mid and upper reaches.

The lower reaches of Fourmile Creek, in the Fourmile Creek subwatershed, have probably always been intermittent. Near the confluence with Lost Creek, stream gradient declines, velocity decreases, the main channel branches, and the substrate changes to unconsolidated alluvial till. This increases the amount of water lost to evaporation and percolation. The historic flow pattern and the resulting intermittent condition is unknown, but was in part determined by flows from the upper reaches of Fourmile Creek and its tributaries.

2. Current Condition/Management Effects

The Fourmile Lake dam has had a significant impact on flows in Fourmile Creek. The dam raised the lake water height 30 feet. Prior to 1915, the Cascade Canal was an earthen and rock structure with a maximum capacity of 80 cfs, and expected flow of not more than 60 cfs. During this time, water losses from the canal were partially intercepted by Fourmile Creek, helping to sustain minimum base flows. The loss of water during conveyance prompted the irrigation district to upgrade the canal to a concrete structure. Upon completion of the upgrade in 1915, the flow regime in Fourmile Creek stabilized into what is present today.

The USGS established a stream flow monitoring gauge at the outlet of Fourmile Lake in the early 1990's. This data was used to construct a hydrograph (see Figure 15) for determining peak flow, bankfull flow, and base flow over a period of time. This information indicates a change from the assumed historical condition.

The dam increased the catchment capacity of the lake. Water supplied during snowmelt is now retained by the dam to refill the reservoir annually. The water retained by the dam represents what would have been historically released into Fourmile Creek in the form of peak and bankfull flows.

The diversion of water from Fourmile Creek has influenced its hydrograph by affecting timing, duration, and quantity of flows. Timing and duration of peak flows has been delayed, as water must now recharge the reservoir an additional 30 feet before cresting the spillway and exceeding the carrying capacity of the Cascade Canal. The quantity of water being supplied to the creek has been significantly reduced during snowmelt, and entirely removed during late summer months by the catchment of the dam and canal system. Currently, late release of snowmelt is retained in the lake. Base flow in Fourmile Creek is now dependent on Horse Creek, springs located on lower and middle terraces, and

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minor leaks in the dam and canal structures. The overall result is that sections of the creek in the Fourmile Creek above Seldom Creek subwatershed which were probably once perennial are now intermittent.

In Horse Creek, flow regimes have been protected by its location along the Sky Lakes Wilderness boundary and the lack of land management activities in its vicinity. It is believed that flow patterns have remained unaltered. Base flows for Horse Creek measured in 1990 were .5 cfs. Peak flows have not been measured.

Lost Creek, Cold Springs Creek, and their tributaries are currently intermittent, with short segments that remain perennial. Timber harvest, road building, and reforestation activities have occurred along Lost Creek from the confluence with Fourmile Creek upstream to within 1.5 miles of the wilderness boundary. Although these activities have had localized impacts to the flow regime, they have not changed the overall hydrograph of Lost Creek. No flow measurements have been recorded for these creeks.

The last two miles of Fourmile Creek in the Fourmile Creek subwatershed have been channelized. Channelization has increased the rate of water transport and lowered the water table, resulting in a decrease in duration of base flows. Although channelization has the potential to increase peak flows, by increasing velocity, this has not occurred because of the Fourmile Lake dam.

Timber harvest and associated activities have taken place within the three subwatersheds since the early 1900's. As discussed under Issue A, species composition and diversity have shifted, but little regeneration harvest has occurred and canopy closure has not been significantly reduced. Thus, it is unlikely that timber harvest has had a measurable effect on the hydrographs of creeks in the watershed.

3. Management Recommendations

a. Restore the channel condition of lower Fourmile Creek, particularly where channelization has occurred.

F. Issue: Stream channel condition has been altered.

Key Questions: What was the historic condition of stream channels in the North Fourmile watershed, and how does this compare with the current condition?

Have stream channels been altered, and if so, how?

Conclusions:

Streams were classified according to the Rosgen Classification System. Higher gradient streams are B type systems. Lower gradient sections in the Lost Creek and Fourmile Creek subwatersheds were classified as C type systems. Diversion of water from the headwaters of Fourmile Creek has reduced channel forming flows. Aggradation is occurring in the Fourmile Creek above Seldom Creek subwatershed just upstream from the confluence with Lost Creek. In the Fourmile Creek subwatershed, aggradation and stream widening have occurred in the Fourmile Flat area. Woodcutters driving in the creek bed have contributed to poor channel condition. The last two miles of Fourmile Creek have been channelized, straightening the channel and lowering the ground water table. Horse Creek, Lost Creek, Cold Springs Creek, and their tributaries, have not been significantly changed by past management. Local areas of increased sedimentation in Lost Creek and slash piles in Cold Springs Creek were identified as problems.

Discussion:

1. Reference Condition/Channel Processes

For the purposes of this analysis, stream channels were classified according to the Rosgen Classification System. A general definition of stream types is included in section IIC3. Within the North Fourmile watershed stream reaches can be divided into two basic types: B and C stream types.

Prior to management activities, upper Fourmile Creek was characterized by a Rosgen B3 type at the headwaters, merging into a B4 type at its confluence with Lost Creek. Approximately a mile downstream from Lost Creek, in the Fourmile Creek subwatershed, the gradient decreased and sinuosity increased. At this point, the channel changed and became a C4 type. Upon entering wetland habitat, the channel became a C5 type. See Figure 8.

Horse Creek was a B4 type at the headwaters, transitioning to a B3 type downstream and finally into a B2 type as it reached the confluence with Fourmile Creek.

Lost Creek began as a B3 type at the headwaters, graded into a C4 type in the low gradient portion of the Lost Creek subwatershed, then returned to a B3 type downstream, as the valley width narrowed and gradient increased.

Cold Springs Creek began as a C3 type, broadening to a C4 type as it skirted around Big Meadows and joined with Lost Creek.

For all stream channel types, the sediment regime was dominated by bank erosion processes. The bank material consisted of unconsolidated, heterogeneous, non-cohesive, alluvial materials.

2. Current Condition/Management Effects

Diversion of water at the headwaters of Fourmile Creek caused a reduction of channel-forming or bankfull flows. This has decreased transport of natural sediment loads and has resulted in streambed aggradation. Instream bar formation, lateral migration, and stream branching are evidence of this aggradation. These features can be seen in the B4 section of the stream, just above the confluence with Lost Creek in the Fourmile Creek above Seldom Creek subwatershed.

In the Fourmile Creek subwatershed, the channel is in the process of reaching an equilibrium with present bankfull flows. Currently, from near the confluence with Lost Creek downstream into the Fourmile Flat area, the channel condition is unstable and susceptible to blowouts from storm events. Aggradation throughout this area has increased the width depth ratio, decreasing pool formation and maintenance, and decreasing sinuosity. Additional bank damage and widening has been caused by woodcutters driving in the streambed to access fallen timber.

Continuous grazing along the lower reach of Fourmile Creek on private land has resulted in streambank instability, increased sedimentation, channel migration, streambed degradation, and the loss of streambank vegetation.

Channelization has significantly altered the channel condition of the last two miles of Fourmile Creek and destroyed its functionality. Sinuosity, side channels, established streambanks, pools, riffles, substrate material, instream woody material, and streambank vegetation historically dissipated energy within this reach. The loss of channel structure has resulted in the elimination of energy dissipating mechanisms, resulting in increased velocity, stream instability, bank erosion, increased sedimentation, and a lowered ground water table.

The channel condition of Horse Creek has remained unaltered by land management activities.

Overall, Lost Creek is in good condition. The lower B3 type reach of Lost Creek has been protected from land management activities by steep valley walls. Rock content is high in upslope areas, and much of the area is unsuitable for timber production. In the C4 and B3 reaches, located farther upstream, there are localized areas where sedimentation has increased because of land management activities. Specific areas include the ford crossing on Forest Road 3659, the Forest Road 3651 crossing, and locations along Forest Road 3651 in Sections 25 and 26. Recreation and firewood cutting activities have increased the number of roads leading to the stream channel off Forest Road 3651. This has increased the potential for accelerated erosion.

Cold Springs Creek, like Lost Creek, is primarily in a good functioning condition, with the exception of a few site-specific alterations. Woodcutters have deposited piles of slash in the Cold Springs stream channel, causing water to become diverted from the channel. This has resulted in channel instability for a quarter mile length in the C4 type of Cold Springs Creek.

3. Management Recommendations

a. Close unnamed firewood cutting/recreation roads off Forest Roads 3651 and 3659 (Sections 13, 14, 23, and 24) and on Fourmile Flat (Section 18) to reduce channel degradation and sediment input. This will also benefit elk/deer habitat (see Issue I). Dispersed campsites and recreation use will need to be considered in road closure proposals for these areas.

b. Remove dams in Cold Springs Creek created by firewood slash.

G. Issue: Degradation of fish habitat has resulted in a reduction of the abundance and distribution of fish species in the watershed.

Key Questions: How have habitat conditions for fish changed?

What is the current condition of fish habitat?

What species no longer utilize the watershed because of habitat degradation?

Conclusions:

Fish habitat has been altered in Fourmile Creek by diversion of water at the headwaters, channelization, and livestock grazing. The amount of perennial habitat has been reduced by dewatering in the Fourmile Creek above Seldom Creek subwatershed, and aggradation is reducing the quality of habitat. In the Fourmile Creek subwatershed, all three mechanisms have combined to remove habitat complexity and access to wetlands and side channels. Bank erosion has been accelerated in this section. Fish habitat remains similar to the reference condition in Horse Creek and Lost Creek. The Forest Road 3459 ford was identified as a localized source of sedimentation in Lost Creek. Lower Fourmile Creek no longer provides fish habitat. None of the species once thought to use this section - suckers, trout, and anadromous species such as steelhead and chinook salmon - currently occur. Anadromous species also no longer have access to Upper Klamath Lake because of dam construction.

Discussion:

1. Reference Condition

Habitat and fish surveys were not conducted in the watershed prior to land management activities that altered the creeks from their historic condition. Anecdotal stories, the geomorphological potential of the systems, and comparisons with similar stream systems in neighboring watersheds were used to reconstruct the reference condition.

Fish habitat in the watershed was stratified into two sections based on general geomorphological characteristics such as gradient and valley width. These sections also correspond with the different subwatersheds.

The upper section lies within the Lost Creek and Fourmile Creek above Seldom Creek subwatershed. It includes Fourmile Creek and its two main tributaries, Horse and Lost Creeks. The streams within this section, with their narrow valley floor widths and steep valley floor gradients, are step-pool systems. Fish habitat was provided through complexity in arrangement of large substrate (cobble and boulders). Pools were primarily small pocket pools. Large wood was a key factor for forming large, deep pool habitat. Spawning habitat was available where gravel accumulated in interstitial spaces associated with larger substrates, and in the tail-outs of large pools created by woody debris. Cool water temperatures were maintained by the forest canopy and steep topography of the terrain. The area supporting riparian vegetation was minimal in width, with little floodplain and side channel development. Lost Creek had

similar habitat conditions, but as an intermittent system, it provided only seasonal foraging and spawning habitat.

The lower section includes Fourmile Creek in the Fourmile Creek subwatershed. This section has a riffle-pool sequence system, with a wide valley floor and a moderate to low gradient. Deep pool habitat in this section was formed by lateral and vertical scour associated with the moderate to high sinuosity of the system. Large wood played a smaller role in habitat development, but was still an important source for hiding cover. Beavers may have created large dam pools ideal for juvenile fish rearing habitat. The occurrence of large wood decreased where riparian vegetation changed from a forested community to a grass-forb wetland community. In these areas, overhanging vegetation and undercut banks provided hiding cover. Smaller sized substrates such as gravel in pool tail-outs and riffles provided ideal spawning habitat for fish. Because the channel was unconstrained by valley width, there was a wider riparian zone and greater floodplain and side channel development than in the upper section. Side channel development most likely increased in the meadows, due to the presence of unconsolidated alluvial material. The lower portion of Fourmile Creek most likely provided excellent spawning and rearing habitat for resident and migratory fish species.

Flows entering Pelican Bay likely attracted spring spawning fish - including suckers, trout, and anadromous species such as steelhead and chinook salmon - to the lower section of Fourmile Creek.

2. Current Condition/Management Effects

Current habitat conditions in Horse and Lost Creeks are similar to the historic condition. Horse Creek in particular remains unaltered; most of this perennial system lies within wilderness. A 1995 stream survey of Horse Creek showed that key habitat features, such as deep pools, large wood, spawning substrates, a riparian zone with large, mature trees (for future wood recruitment), and cold temperatures (4 degrees Celsius during summer months), remain intact and provide excellent fish habitat. Lost Creek continues to provide seasonal foraging and spawning habitat. A localized area of concern was identified for Lost Creek. Increased sediment enters Lost Creek at the Forest Road 3659 ford. Vehicles crossing the creek stir up sediments, which are collecting in pools downstream. This downstream section is the only part of Lost Creek that remains perennial, and the pools are important to fish that remain in Lost Creek during the summer, after the downstream connection to Fourmile Creek dries up.

Changes in the fish habitat of Fourmile Creek have been more significant than in the major tributaries described above. This is the result of three primary mechanisms: the dewatering of Fourmile Creek at its headwaters, grazing, and channelization. Habitat has been degraded less in the upper section of Fourmile Creek where a B type channel is present than in the lower section, where the system changes into a C type channel. C type channels are sensitive to disturbance, and the combination of impacts in this section has destroyed the excellent fish habitat that historically existed, particularly within the last two miles of Fourmile Creek.

Dewatering has caused the upper section of Fourmile Creek, which is believed to have been perennial, to become predominantly intermittent with short perennial sections maintained by springs and Horse Creek. This has decreased the amount of habitat for fish, and reduced the carrying capacity of the stream. Although

base flows are imperative for providing year-round habitat, the loss of bankfull flows has also degraded the quality of fish habitat in this section. The system is believed to be aggrading; working to build the streambed up to be in equilibrium with current flows. Width-to-depth ratios have increased, filling in pools and creating shallower depths throughout the system. As a result, forage, hiding, and resting habitat has been reduced.

In the Fourmile Creek subwatershed, habitat complexity within Fourmile Creek was lost as channelization destroyed the riffle-pool sequence and removed large wood from the last two miles. Channelization lowered the water table and prevented access to side channels and wetlands that once provided excellent rearing habitat for fish. Grazing livestock have increased bank instability. Banks have collapsed, the undercut banks and overhanging vegetation of the channels are gone, and width-to-depth ratios have increased. These problems have been compounded by decreased flows; the banks are in a constant state of flux within the last two miles, causing increased sedimentation. Today, there is no spawning, rearing, or hiding habitat available within this lower reach.

Changes in habitat have altered fish abundance and distribution in Fourmile Creek. Because the amount of perennial habitat has been reduced, the system does not support as many fish for as long a time during the year. None of the fish species which historically used the lower reach still occur in that section. Some lake species, such as dace, have been observed in the channelized reach, but use is likely to be incidental. Habitat has been so altered that neither brook trout nor redband trout use this reach, even though they occur in the watershed and in Upper Klamath Lake, respectively. Endangered sucker species, once recorded at Harriman Springs, and reported by local residents to have spawned in Fourmile Creek (Mike Green, pers. comm.), no longer occur at the spring or in the creek. Chinook salmon and steelhead are blocked from reaching Upper Klamath Lake by dams on the Klamath River.

3. Management Recommendations

a)Because information is limited, aquatic inventories for amphibians, macroinvertebrates, and fish should be conducted. Horse Creek, in its undisturbed condition, could supply reference condition data. Although Horse Creek is a priority, these inventories should be done on all creeks in the watershed.

b)Monitor and assess the sources and amount of sediment loading in lower Fourmile Creek. Initial observations indicate that grazing on private property is producing a high sediment yield during peak flows. If monitoring indicates this is true, the District should attempt to coordinate with the private landowner to reduce sediment production. This type of project could potentially be funded through the Ecosystem Restoration Office (ERO). The District should develop a sediment monitoring plan, and share this information with other agencies interested in protecting the Mare's Eggs at Harriman Springs.

c) The ford on Forest Road 3659 needs to be evaluated. The current road surface does not adequately support passenger vehicles when Cold Springs Creek is flowing. Sediments are transported into downstream fish-bearing habitat. It may be necessary to improve this crossing to support future traffic needs.

H. Issue: Native fish populations are nearly extirpated.

Key Question: What native fish species historically occurred in the watershed and what is the current status of native populations?

How has the introduction of non-native species impacted native fish distribution?

Conclusions:

The watershed may have historically provided habitat for bull and redband trout, in addition to suckers and anadromous fish listed under Issue G, which used the lower reach of Fourmile Creek for spawning. Native species are currently rare in the watershed. A single redband trout has been sampled in Fourmile Creek in recent years. Bull trout have not been located; however, potential habitat for bull trout is present in Horse Creek. Although habitat degradation is considered a main factor in loss of suckers and anadromous fish, introduction of brook trout is thought to have been more important in impacting native trout. Brook trout compete with native trout for resources and also hybridize with bull trout. Surveys should be done to determine if bull trout are present, and if so, the population should be protected.

Discussion:

1. Reference Condition

There is no record of fish surveys being conducted prior to initiation of a fish-stocking program in the early 1900's. References in literature and anecdotal stories indicate that historically, species such as the Lost River and shortnose sucker, steelhead, chinook salmon, and redband trout (resident and adfluvial) may have occurred in Fourmile Creek (Larry Dunsmoor, pers. comm.; Fortune, 1966). Based on habitat features currently found in Horse Creek, it is possible that bull trout (resident and adfluvial) were also present.

2. Current Condition/Management Effects

a) Current Distribution of Fish

Currently, none of these native species are known to occur in the watershed, with the exception of redband trout. A single redband was sampled in 1992 in Fourmile Creek just below its confluence with Lost Creek.

Potentially, bull trout may occur in Horse Creek. Initial surveys indicate the deep pools, large wood, and cold temperatures are ideal for meeting the life history requirements of bull trout. Bull trout currently occur, or have been recently extirpated, in neighboring watersheds that offer habitat of lesser quality (e.g., Threemile Creek).

In the early 1900's, brook trout were introduced into Fourmile Creek. They spread throughout the system and currently inhabit all perennial sections of Horse, Lost, and Fourmile Creeks.

b) Causes of Decline

Loss of suckers and anadromous species is likely a result of habitat degradation, (and also dam construction for anadromous species), as addressed under the previous issue. Although habitat degradation has probably affected native trout as well, more important may be biological interactions and the introduction of brook trout. This issue was identified in neighboring watersheds, where brook trout are thought to have caused decline or extirpation of native populations.

Native fish species evolved together, and for the most part, developed temporal and spatial partitioning of resources. Introduced species such as brook trout can disrupt this natural allocation of resources, displacing natives through competition for food, space, and cover. This may lead to an exclusion of native fish from their habitat, reducing their capability to spawn, feed, or grow. This displacement appears to be impacting redband trout, considering the extremely low sampling frequency of redband in the watershed.

If bull trout are present, hybridization may also be occurring. Brook trout are able to hybridize with bull trout, making them a serious threat to bull trout populations (Ratliff and Howell, 1992; Markle, 1992). These species belong to the same genus, spawn at the same time, and are able to produce hybrid offspring. However, life history differences favor brook trout; they reach sexual maturity at a younger age and are more prolific than bull trout. This leads to the displacement of bull trout (Ratliff and Howell, 1992). Hybridization often results in sterile offspring, thus leading to the gradual depletion of the bull trout gene pool and a trend toward extinction (Howell, 1992). Extensive fish surveys are needed to determine if bull trout exist in Horse Creek. If they do, bull trout habitat should be protected from brook trout invasion.

3. Management Recommendations

a. Conduct snorkel and electroshock fish surveys in Horse Creek to determine the presence/absence of bull trout.

b. If bull trout are found in Horse Creek, include this new information in the Klamath Basin Bull Trout Conservation Strategy Plan so a recovery plan for this population can be developed in conjunction with other bull trout populations in the basin.

c. It may be necessary to add a fish screen to Fourmile Dam to ensure that brook trout in the lake do not escape into downstream habitat. This would prevent further brook trout introduction into native fish habitat, and would increase in importance if bull trout are found in the watershed. A fish screen would also prevent the State of Oregon's annual investment of fish stocked in Fourmile Lake from escaping into downstream habitat, where they could potentially become land locked and die.

I. Issue: Planning teams need additional guidance on how to manage riparian reserves in the watershed.

Key Questions: Where are riparian reserves located?

How does the current condition and functioning of riparian reserves compare to the reference condition?

What species use riparian habitats?

What types of management activities would benefit riparian reserve functioning?

Conclusions:

The North Fourmile Watershed has a high density of riparian areas, with the greatest density located in wilderness. Riparian reserve widths generally follow Forest Plan recommendations; no unstable areas were identified for inclusion. The team labeled lodgepole pine stands in the Lost Creek and Fourmile Creek subwatersheds as riparian areas.

Riparian reserves outside wilderness were divided into three sections for discussion:

Section A in the Fourmile Creek subwatershed: This area has flat topography and broad floodplains. Activities such as channelization, diversion of water at Fourmile Lake, grazing, and development have affected riparian reserves. A diversity of riparian habitats occurred historically and is still present: lodgepole pine, meadow, mixed conifer, and hardwood. Disturbance in the form of fire, insects, flooding, and blowdown has been prominent over the last 100 years. Spotted owl habitat has been minimal. The area provides important deer fawning and elk calving habitat. Great gray owl habitat is also present. Much of the forested area has been harvested this decade. Recent blowdown is also discussed. Designated road density is low, but several unnamed roads have been created by recreationists/firewood cutters.

Section B, higher gradient streams in all three subwatersheds: Riparian zones are narrow and mostly forested with Shasta red fir and/or white fir. Spotted owl NRF and dispersal habitat is currently, and was historically, abundant. Logging along the mainstems has been minimal, but small tributaries have been impacted by past timber harvest and road building. Road density in the reserves of the tributaries is high.

Section C in the Lost Creek subwatershed: This glaciated basin contains several meadows, pothole lakes, and small drainages. Timber extraction has been mostly limited to firewood cutting. Past fires created seral lodgepole stands that are likely to die of pine beetle infestation in the next 20 years. Little NRF or dispersal habitat has been present since 1940. This is an important fawning/calving area and has suitable great gray owl habitat. Designated road density is low; however, spur roads have been created by recreationists and firewood cutters.

In addition to providing habitat components for deer, elk, and great gray owls, riparian areas are important to bats, sandhill cranes, neotropical migratory birds, amphibians, and cryptogams.

Management recommendations and potential treatments are listed.

Discussion:

1. Location of Riparian Reserves

Figure 16 shows the location of recommended riparian reserves in the watershed, which total approximately 5,280 acres (this figure excludes the water surface in Fourmile Lake). In general, reserve widths follow Forest Plan standards and guidelines: 320' (two site potential trees) for perennial stream segments, intermittent fish-bearing streams, and lakes; 160' (one site potential tree) for springs, wetlands greater than 1 acre, and non-fish bearing intermittent streams. Lodgepole pine stands on Fourmile Flat and in the Cold Springs basin were also included in riparian reserves. The dominant plants in these areas are not obligatory hydrophytes and soils are not hydric, but significant water flow and/or ponding occur during the spring. The Winema Forest Plan also includes lodgepole stands on Fourmile Flat in riparian management. The watershed analysis team did not identify any unstable areas to be included in riparian reserves.

The boundary between the Fourmile Creek subwatershed and adjacent Varney Creek subwatershed is not sharply differentiated. Riparian areas located outside the North Fourmile boundary, which are contiguous with those inside the boundary (e.g., Fourmile Flat and Pelican Barn Meadow), were considered in the analysis of this issue. Although the largest concentration of riparian reserves are located in wilderness around numerous pothole lakes, management of wilderness riparian reserves is not included in this issue. Wilderness objectives and guidelines are already clearly defined.

For the purpose of this analysis, the watershed was divided into 3 main riparian sections, excluding wilderness, based on stream reaches and riparian characteristics. These are analyzed in more detail below (see Figure 17).

2. Reference Condition and Function in the Watershed

Section A: Riparian areas along Fourmile Creek in the Fourmile Creek subwatershed, including associated wetlands (1,281 acres).

These riparian areas formed on the glacial outwash fan of Fourmile Creek and were influenced by flat topography and low elevation. The floodplains and riparian zones were wide, with multiple side channels and wetlands. Wetlands became innundated in the spring and meadows stayed wet into the summer. Poorly drained soils were important in water storage and release. High water tables, along with fire frequency, regulated soil nutrient cycling and micro-organism populations. Rates of decay were slow in saturated soils.

In 1940, riparian areas had diverse vegetation. Dense, young lodgepole-dominated stands covered a majority of the forested areas and provided deer fawning and elk calving habitat. These probably resulted from past

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stand-replacing fires. Downed wood and snags were likely abundant in these stands. Mixed conifer stands were more open and provided large pine and Douglas-fir, suitable for species requiring large trees for nesting and roosting habitat. Meadows covered nearly a third of the riparian areas, hardwoods approximately 10%. Little NRF or dispersal habitat was present. Great gray owls probably foraged in the meadows and nested in adjacent stands.

In all the sections, streamside riparian vegetation was important in development of channel conditions and aquatic habitat, supplying large wood, shade, nutrient input, and bank stabilization (See Issues F and G).

Section B: Fourmile Creek in the Fourmile Creek above Seldom Creek subwatershed; Horse Creek; Lost Creek, from the confluence with Fourmile Creek to just above the Forest Road 3651 crossing in Section 26; and intermittent streams on the south side of Pelican Butte (908 acres).

The riparian reserves along these streams had higher gradients than the lower section of Fourmile Creek. Banks rose steeply from the channels; floodplains and riparian zones were narrow in width. Few side channels or wetlands developed. Small springs were numerous along the banks in some areas, contributing to base flow. In 1940, vegetation was mostly white fir and/or Shasta red fir-dominated with a significant Douglas-fir component. However, ponderosa pine, white fir, and Douglas-fir mixed conifer predominated on the south side of Pelican Butte and along the lower elevation areas near the confluence of Fourmile and Lost Creeks. Canopy closure was moderate to high, and stands were generally late or mid seral, providing NRF and/or dispersal habitat along most of the stream lengths. Snags, downed wood, and hiding cover were likely abundant.

Section C: Lost Creek above the Forest Road 3651 crossing, Cold Springs Creek, Big Meadows, and associated wetlands in the Cold Springs basin (801 acres).

In addition to riparian areas associated with streams, the relatively flat, hummocky topography created by glaciation in the Cold Springs basin resulted in many wetlands, emphemeral drainages, and small lakes. Except for meadows, soils were generally rocky and well drained. However, an impervious layer of dense glacial material at 15-30" below the surface limited downward movement of water and contributed to the high number of riparian areas. Meadows provided water storage and slow release. Cold Springs and several smaller springs arose in this area, creating short sections of perennial flow and wetlands.

Vegetation in riparian reserves consisted primarily of young lodgepole pine stands with variable canopy closure in 1940. Mid and late seral Shasta red fir and mountain hemlock/Shasta red fir stands were also present. Meadows comprised about 12% of the riparian reserves. Hiding cover and fawning/calving habitat was probably present in the dense lodgepole pine stands. Some of the Shasta red fir and mountain hemlock/Shasta red fir stands provided suitable dispersal and NRF habitat, but such habitat was lacking in the rest of the section. Snags and downed wood were probably abundant in most of the forested area. Great gray owl habitat was present.

3. Current Condition and Management Effects

Section A

Many activities affected riparian reserves in this section: channelization, the water diversion created by Fourmile Dam, grazing, seeding of exotic plants, timber harvest, fire suppression, road construction, and private development. In addition, a recent blowdown event has occurred.

Channelization of the last two miles of Fourmile Creek and downcutting caused by grazing on parts of private land have lowered the water table. This has resulted in water being more quickly removed from the system, less flooding, loss of side channel flow, and probably a shorter duration of inundation and flow than in the past. Water diversion contributed to these conditions, as described under Issues E and G.

Species composition in meadows may have shifted as a result of the lowered water table and reduction in the time of inundation. Although parts of Pelican Barn meadow remain sedge or tufted hairgrass-dominated, bluegrass is common on some of the drier sites. Exotic grasses have been seeded at Pelican Barn and probably also in private meadows and yards.

The effects of fire suppression have been discussed under Issue A. Fuels and tree mortality are currently high in densely stocked riparian stands near Rocky Point. Many of the stands are within 300 feet of meadows and overlap with buffers designated as great gray owl habitat. In the absence of fire, lodgepole pine and aspen are encroaching around meadow edges.

Dense lodgepole stands on Fourmile Flat were attacked by pine beetles in the late 1980's and were subsequently treated as part of the Swamp Timber Sale. Many of the private lands have also been recently logged. As a result, most of the lodgepole stands on Fourmile Flat have been thinned, and small group regeneration units have been added. Groups are planned for planting with Englemann spruce, to provide species and structural diversity. A one-hundred foot uncut buffer was left along both sides of the creek on NFS lands, to maintain fawning/calving habitat.

In 1996, a blowdown event in some of the thinned units and adjacent stands created large openings in the lodgepole habitat. Blowdown totals approximately 500 acres (half on private and half on NFS lands), with the largest block being over 100 acres. Soils in the blowdown areas rarely dry out sufficiently to meet soil moisture restrictions for logging or mechanical site preparation. Heavy fuel loading is a concern for the following reasons: although the area is inundated in spring, fuels dry out during the hot summer months; incidence of human-caused fire starts is high; potential for spread to private property is high. Furthermore, a large amount of dead lodgepole on the ground would attract firewood cutters to create roads into blowdown areas. Ground cover is establishing rapidly in the openings. Graminoids and forbs are already abundant; growth of shrubs, resprouting of hardwood trees, and some regeneration of lodgepole pine is occurring. The amount of hardwood habitat in this section is expected to greatly increase as a result of the blowdown.

The density of designated roads in the riparian reserve is approximately 1.9 miles/square mile. An unknown number of miles of road have been created by recreationists and firewood cutters on Fourmile Flat.

Private land totals almost half (615 acres) of the riparian reserves. In the Rocky Point area, over 30 structures have been built within the riparian reserve boundaries on private land. Clearing, road construction, and introduction of exotics have accompanied development in many areas.

Section B

The riparian reserves in this section lie wholly or in part within the boundaries of the LSR.

Riparian reserves along the mainstems have been little affected by past management. Canopy closure has increased over time in the absence of fire. A small amount of timber harvest has occurred. Most of the reserves along the mainstems currently meet both NRF and dispersal habitat requirements. Downed wood, snags, and hiding cover are abundant.

Several of the small intermittent tributaries of Fourmile and Lost Creeks and the unnamed streams on Pelican Butte have been impacted by past timber harvest and road construction. In particular, the westernmost stream on Pelican Butte has been crossed several times by roads and skid trails. Road density in this section is higher than in the other two, at 2.8 miles/square mile, largely because of roads intersecting the reserves of small tributaries.

Section C

Little timber harvest has occurred in the riparian reserves of this section, and canopy closure has increased since 1940. Most of the large-scale firewood cutting in the Cold Springs basin took place outside of riparian reserves, except where reserves lie in close proximity to the major roads. Firewood cutting units are no longer located in this area.

Although current mortality and fuels are low to moderate, lodgepole pine stands are likely to succumb to pine beetles and die over the next 20 years, creating jack-straw fuels, and attracting firewood cutters.

In general, riparian reserves in this area still do not meet either dispersal or NRF habitat requirements.

Forest Road 3651 parallels sections of both Lost and Cold Springs Creeks. Overall, the density of designated roads is approximately 2.1 miles/square mile. Short roads used for recreation and firewood cutting have been created off Forest Roads 3651 and 3659 in some areas.

4. Riparian Habitats

A number of species use riparian areas, others depend on riparian areas to meet all or part of their habitat requirements. Habitat for species of interest to management are discussed below.

a. Great Gray Owls

For this analysis, potential great gray owl habitat was defined as conifer stands 80 years or older within 1,000 feet of meadows greater than 10 acres in size (see USDA unpublished). Areas surrounding networks of smaller meadows were also considered as habitat. All of the great gray owl protection buffers mandated by the Forest Plan are included within the estimated potential

habitat. Because meadows occur almost exclusively in areas with high water tables on the Klamath District, much of the great gray owl habitat occurs within riparian reserves. Surveys on other Districts of the Forest indicate the owls also nest in relatively open stands with large pine, similar to bald eagles, as long as suitable nest trees are available. It is presently unknown if great gray owls use stands around clearcuts on the District, as they do elsewhere in Oregon.

In the North Fourmile watershed, habitat is concentrated around meadows in Sections A and C. Habitat totals approximately 1,518 acres, including 507 acres on private land. An additional 281 acres of suitable habitat are present near Pelican Barn, just outside the watershed boundary. In the lower Fourmile drainage, past logging of ponderosa pine, mortality caused by insects, and fire suppression have reduced the suitability and long-term stability of the habitat.

To date, no formal standardized inventory has been conducted on the District. Since 1988, four sightings of great gray owls have been recorded in the North Fourmile area.

b. Deer and Elk

Elk are known to use the riparian areas of Big Meadows and Fourmile Flat, as well as portions of Sky Lakes Wilderness. Elk are more abundant today around Pelican Butte than in the recent past, as a result of increased forage in created openings (Ralph Opp, pers. comm.). Deer are also plentiful in these areas, as well as near Pelican Barn and Fourmile Lake. The riparian zone in Fourmile Flat was identified as an important deer fawning and elk calving area during the Bugsy Environmental Assessment.

Deer hiding and thermal cover are well distributed in riparian areas as well as in upland areas. Most stands without recent harvest provide sufficient cover.

During watershed analysis in the Threemile, Sevenmile, and Dry Creek Watersheds, high road densities, particularly in riparian areas, were identified as causing a decrease in habitat effectiveness for big game. Road densities in the riparian areas of North Fourmile are generally low, relative to the rest of the District, and overall, are not a concern. However, blocking roads created by woodcutters in the Big Meadows and Fourmile Flat areas could have a positive effect on deer and elk fawning/calving habitat.

c. Amphibians

Key areas of amphibian habitat include Big Meadows and the streams entering and exiting the meadow, Fourmile Rock Quarry, wet meadows around the southern end of Fourmile Lake, and the numerous ponds, pump chance sites, and wilderness lakes within the watershed (Nauman, 1995). Future surveys are needed to better assess abundance and distribution of amphibian species and their habitats.

d. Cryptogams

Many of the survey and manage bryophytes and lichens listed in the Forest Plan would most likely occur in riparian reserves, if they are present in the watershed. Observation indicates diversity of fungi also increases in riparian areas. Data are not currently available for these species.

e. Other Riparian Species

Greater sandhill cranes and bats are known to use the meadows of the North Fourmile Watershed. Mixed conifer and hardwood stands in riparian zones may be important for some species of neotropical migratory birds. Sensitive plant species in riparian areas are discussed under Issue B.

5. Management Recommendations

Many recommendations that would affect riparian reserves are already listed under Issues E, F, and G and are not repeated here. See also Appendix D for a list of potential WIN inventory projects in the watershed.

a. Re-introduce fire to meadows to reduce lodgepole pine and aspen encroachment.

b. Protect meadows from disturbance and soil damage by motorized vehicles, including ATV's.

c. Commercial harvest treatments in riparian reserves should be helicopter yarded, or conducted when the soil is frozen and 24" of snow are present on the ground. Monitoring indicates little soil compaction or displacement occur when these conditions are met. Snow/frozen ground conditions rarely occur in Section A. In this section, potential soil damage will have to be weighed with other riparian resource concerns on a site-specific basis.

d. Road construction and reconstruction in riparian reserves should be avoided, except for restoration purposes (e.g. culvert replacement, waterbarring, etc.). Overall, decreasing road density in riparian reserves will reduce runoff and sediment loading. Appendix D lists roads recommended for closure.

e. Blowdown material on Fourmile Flat in Section A should be salvaged to lower fire hazard. Remaining fine fuels should meet but not exceed Forest Plan recommendations.

f. In general, natural regeneration should be allowed to occur in riparian reserves, including the blowdown units in Section A, where sufficient cover to meet riparian reserve functioning is already developing. Planting using hand scalping may be beneficial on selected sites, to enhance species diversity or wildlife habitat.

g. Historical information, the functioning of the stream system, and recent events suggest Section A is subject to frequent disturbance. Suitable spotted owl habitat has been minimal during the past 50 years, and connectivity is interrupted by natural openings. It may be more logical to manage for a diversity of riparian habitats and wildland-rural interface concerns, rather than spotted owl habitat in this section.

h. Thinning followed by periodic prescribed fire could be used to restore mixed conifer stands in the riparian reserves of Section A to historical conditions, and maintain/develop large diameter pines.

i. Riparian reserves in Section B should be managed similarly to the rest of the LSR, as outlined in the LSR Assessment. The emphasis should be on maintaining NRF habitat over the long term.

j. The riparian reserves of logged-over tributaries in Section B should be further evaluated to determine if road closure and/or restoration opportunities are present. However, restoration of these tributaries will be a lower priority than restoration of fish-bearing streams.

k. It is likely that additional riparian areas will be found in the Lost Creek subwatershed (Section C) during project layout. Over snow/frozen ground may be a useful mitigation to protect areas with many unmapped small ephemeral streams and wetlands.

l. Initiating thinning treatments in lodgepole pine stands in Section C at this time could be used to slow mortality rates. This would reduce future fuels buildup, and limit firewood cutting and road creation. Continuity of fuels and access should be considered, prior to proposing treatments.

m. Conduct surveys for great gray owls using Regional protocol (scheduled to begin in 1996).

n. Maintain or enhance mature or old-growth lodgepole pine or mixed conifer stands within 1,000 feet of meadows (great gray owl habitat).

o. During management activities, large diameter snags (including broken top snags) and downed logs should be protected in riparian reserves to the extent feasible. Install nesting platforms where nest sites are deficient in great gray owl habitat.

J. Issue: The North Fourmile Watershed area contains a large concentration of historical sites and railroad grades resulting from past railroad logging. These sites need to be addressed during project planning and implementation.

Key Questions: What is the significance of these sites?

Have the sites been impacted?

How should these sites be managed?

Conclusions:

The railroad system was built to log some of the first timber sales in Forest Service history. The historic sites and grades provide information about the chronology of the logging industry, early forest management issues, the development of industrial technology, and social and economic issues of the times. Many of the grades have been impacted by past timber harvest and road building. Currently most sites remain intact, but illegal artifact collection is increasing. Overall, the archeological record is deteriorating. An inventory of the railroad system and other historic sites in the watershed should be conducted. Further, an analysis should be conducted to determine if the area constitutes an Historic District, for which a specific management plan should be developed.

Discussion:

1. Reference Condition and Historical Significance

Railroad logging activities began in the watershed area in 1911 and continued until about 1930. Establishment of these railroad systems was tied to development of a National Forest System designed to supply a sustained yield of timber products to the nation, as well as the development of the local economy and settlement during the early part of the twentieth century. The watershed witnessed one of the earliest timber sales (the Fourmile Sale) on the then Crater National Forest. In fact, the Fourmile Sale was the impetus for the creation of the Pelican Bay Lumber Company which operated in the Klamath Basin for many years and "whose practices were to set the standards for the industry in Klamath Falls" (Tonsfeldt, 1988).

The significance of the grades and associated sites and features of the Fourmile System is tied to a multiplicity of factors. Tonsfeldt (1987) noted, when first beginning to research historic railroad logging on the Winema National Forest, that such information was important because:

> It establishes the essential chronology of the industry, with documentation of forest management isssues, industrial technology, the social issues in timber-dependent communities, business cycles in the lumber industry, the geographical distribution of historic sites, and data comparing Klamath County's industry to that of the rest of the country (Tonsfeldt, 1987:1).

The Fourmile Railroad System consisted of a network of nearly 30 miles of railroad grades and various camps and features related to logging activities. Large camps were used for administrative purposes, to house men who worked in the woods, to service railroad and logging equipment, and in general as sites for conducting field operations. Smaller camps were more likely associated with smaller work groups and possibly with functions such as grade maintenance, lunch stations, or other activities that would involve a number of people or were of long enough duration that refuse would accumulate. Other sites associated with the railroad grades included landings where logs were brought for loading onto railroad cars for transport elsewhere. Because the North Fourmile area was among the earliest settled by Euroamericans, some sites in the watershed may be attributable to activities other than railroad logging, such as recreational hunting camps.

The Fourmile railroad system was developed by two entrepreneurs from San Franscisco (Harold Mortenson and G.D. Hauptman) who formed the Pelican Bay Logging Company for the express purpose of buying the Fourmile Timber Sale offered by the Crater National Forest in 1910. While not necessarily the earliest railroad logging system developed, it was among a group of early systems within the newly-formed National Forest System and also marked the beginning of an era of reliance by mills and lumber companies on Federal lands. In previous times, lumber companies and mills purchased their own lands for logging.

World War I occurred during the first several years of the Fourmile System. Questions exist as to how increased industrial activity during this era is reflected archeologically, and how much of the system was constructed during the war years. Productivity may have increased due to the war effort, and there may have been social ramifications, such as changes in the structure of the family and of the work force.

By 1916, Pelican Bay reportedly had as many as 250-300 men working on the Fourmile Sale and had three major camps to support this effort. By 1919 the entire system had been developed. Use of the railroad system continued through about 1920, when a transition from rail-based logging and transportation shifted to a truck-based system.

During its development and transition, the Fourmile System faced technological barriers not found in other areas. Compared with the Klamath Indian Reservation (now part of the Chiloquin and Chemult Ranger Districts), the Fourmile watershed was steeper and more heavily timbered. The development of logging technology was at least as important as the constraints placed on the transportation system. Tonsfeldt (1987) documents discussion and debate between the Forest Service and Pelican Bay Lumber Company over the use of "donkey" or steam engine-based skidders as opposed to use of horses or other developing mechanized equipment. The issues primarily were related to damage of the residual timber stand. Specific questions regarding the different technologies used for logging and transportation within the watershed include: a) when did the shift from rail to truck-based logging take place, and b) how are these changes manifested archeologically?

Some of the silvicultural concerns driving the need for timber harvest in the first quarter of the century were similar to those of today. Early correspondence between Forest Service and Pelican Bay Lumber Company officials suggests that overstocked white fir stands were posing a threat to the more desirable ponderosa or yellow pine. These same files also suggest that there

was considerable debate as to what was commercially significant and effective for the lumber companies to harvest. Pelican Bay officials complained frequently that having to harvest white fir as "little" as 20" in diameter was an economic burden, and asked to be allowed to deck such material as cull or unmerchantable. Economic factors (as opposed to strictly forest management issues) are likely to have influenced significantly how Pelican Bay Lumber Company was able to conduct their timber harvest operations and may have played as big a role as, if not bigger than, technological constraints (though these two issues cannot be easily separated).

2. Current Condition and Management Effects

The railroad grades are distinguishable by the presence of a number of features related to their construction, including (among others) raised roadbeds and earthworks, cribbed log trestles, bridges, and culverts. While many of the railroad grades have been used as roads, these features are generally distinguished from road systems by the combination of several of the above features, as well as low gradient (<8%), and a wider turn radius than those found on routes designed for motor vehicles.

Sites in the watershed generally exhibit fair to good levels of integrity; that is, the sites, while not in pristine condition, are typically intact and have not been seriously impacted. The railroad system, however, overall exhibits more damage from past management activities. Tonsfeldt estimated in 1988 that while eight miles of the "East Branch" of the system appeared to be intact, less than five out of about 20 miles within the "West Branch" could clearly be identified on the ground. The source of damage to these grade systems has historically been logging-related development. As areas have been entered in modern times, railroad grade segments were used for roads, or were destroyed during post-harvest activities (such as site prep). At this time, the actual percentage of the railroad grade system that is intact or damaged is unknown.

In addition to agency actions, there appears to be a general increase in illegal collection of artifacts from historic sites in this area. Overall, the historic archeological record is in a deteriorating condition within the watershed, though the rate of degradation is unknown.

3. Management Recommendations

a. Gather information with oral history interviews and archival research and validate this information with the archeological record. Validation should include an inventory of the railroad system and other historic sites so that the actual numbers of sites (and length of linear features such as railroads) and their conditions are known. Only from such an inventory can sound management recommendations be made.

b. Distinguish among sites created by different, though similar, activities such as camps generated by a working party versus those created by recreational hunters.

c. An analysis should be conducted to determine if the area constitutes an Historic District. The benefit of this designation would be that a specific management plan would then be developed, which would allow management decisions about site protection to be made programmatically, rather than on a site-by-site basis, as is currently practiced.

V. MANAGEMENT RECOMMENDATIONS LISTED

A. Sensitive Plant Species

1. Mt. Mazama Collomia

a) Thin mature lodgepole stands to retain existing habitat as long as possible, maintaining an overall canopy closure of 40% or greater.

b) Use small group selection cuts in areas not currently occupied by collomia to create edge habitat and regenerate lodgepole pine. Leave 15% canopy closure in the groups and underburn.

c) Maintain and/or speed development of mature Shasta red fir/mountain hemlock stands, with small gaps and partially open canopies. This may include thinning from below to a canopy closure of approximately 50%.

d) Experiment with prescribed fire where feasible to remove duff and understory vegetation.

e) Log over snow in currently occupied areas to prevent destruction of plants.

f) Monitor treatment units for effectiveness.

2. Pygmy Monkeyflower

The following should occur prior to initiating restoration of lower Fourmile Creek:

a) Determine whether the benefits of a restoration project justify the risk of extirpation of pygmy monkeyflower on the Klamath District.

b) Evaluate the importance of the pygmy monkeyflower population at Pelican Barn to the viability of the species as a whole.

c) Determine whether mitigation measures could be used to lower risk of extirpation at the site. Some examples might include collecting soil likely to contain seed prior to project implementation, and redistributing the soil following project completion.

3. Red Root Yampa and Sticky Catchfly

The following should occur prior to initiating restoration of lower Fourmile Creek:

a) Determine the current distribution, abundance, and habitat requirements of red root yampa.

b) Evaluate the potential for detrimental changes to the habitat of both species.

B. Upland Wildlife Habitat

1. LSR/NRF Habitat

a) Maintain existing NRF and speed development of future NRF habitat on the south-southwest slope of Pelican Butte within the LSR.

b) Maintain the current connectivity of NRF habitat within the LSR and between the North Fourmile watershed and adjacent watersheds.

2. Low Elevation White Fir Habitat

a) During management activities retain all large pine and Douglas-fir snags where feasible. Manage stands to grow large recruitment trees.

b) Where conflict exists between management for bald eagle and spotted owl habitat in LSR, the following should be considered:

The health and status of the bald eagle population in the Klamath Basin and in the state of Oregon compared to the health and status of spotted owl populations on the District and in the Pacific Northwest.

The availability of spotted owl habitat corridors between the North Fourmile watershed and adjacent watersheds.

The sustainability of spotted owl habitat in bald eagle management areas.

C. Erosion/Soils

1. Unnecessary roads and roads difficult to maintain should be targeted for removal.

2. Roads within 320' of streams should be removed where feasible. Roads that are retained should be upgraded and maintained at the necessary standard in order to limit the transport of sediments.

3. Activities should be carefully planned on slopes greater than 35 percent and in areas with sensitive soils to avoid further accelerating erosional processes.

4. Soil moisture standards of 17% should be applied to all projects requiring use of heavy equipment in order to prevent additional detrimental compaction. Over-the-snow logging should be employed in areas where soil moisture standards cannot be achieved.

5. Sub-soiling should be used to rehabilitate compacted areas where feasible.

D. Hydrology

1. Restore the channel condition of lower Fourmile Creek, particularly where channelization has occurred.

2. Close unnamed firewood cutting/recreation roads off Forest Roads 3651 and 3659 (Sections 13, 14, 23, and 24) and on Fourmile Flat (Section 18) to reduce channel degradation and sediment input. This will also benefit elk/deer habitat (see Issue I). Dispersed campsites and recreation use will need to be considered in road closure proposals for these areas.

3. Remove dams in Cold Springs Creek created by firewood slash.

E. Fish

1. Because information is limited, aquatic inventories for amphibians, macroinvertebrates, and fish should be conducted. Horse Creek, in its undisturbed condition, could supply reference condition data. Although Horse Creek is a priority, these inventories should be done on all creeks in the watershed.

2. Monitor and assess the sources and amount of sediment loading in lower Fourmile Creek. Initial observations indicate that grazing on private property is producing a high sediment yield during peak flows. If monitoring indicates this is true, the District should attempt to coordinate with the private landowner to reduce sediment production. This type of project could potentially be funded through the Ecosystem Restoration Office (ERO). The District should develop a sediment monitoring plan, and share this information with other agencies interested in protecting the Mare's Eggs at Harriman Springs.

3. The ford on Forest Road 3659 needs to be evaluated. The current road surface does not adequately support passenger vehicles when Cold Springs Creek is flowing. Sediments are transported into downstream fish-bearing habitat. It may be necessary to improve this crossing to support future traffic needs.

4. Conduct snorkel and electroshock fish surveys in Horse Creek to determine the presence/absence of bull trout.

5. If bull trout are found in Horse Creek, include this new information in the Klamath Basin Bull Trout Conservation Strategy Plan so a recovery plan for this population can be developed in conjunction with other bull trout populations in the basin.

6. It may be necessary to add a fish screen to Fourmile Dam to ensure that brook trout in the lake do not escape into downstream habitat. This would prevent further brook trout introduction into native fish habitat, and would increase in importance if bull trout are found in the watershed. A fish screen would also prevent the State of Oregon's annual investment of fish stocked in Fourmile Lake from escaping into downstream habitat, where they could potentially become land locked and die.

F. Riparian Reserves

1. Re-introduce fire to meadows to reduce lodgepole pine and aspen encroachment.

2. Protect meadows from disturbance and soil damage by motorized vehicles, including ATV's.

3. Commercial harvest treatments in riparian reserves should be helicopter yarded, or conducted when the soil is frozen and 24" of snow are present on the ground. Monitoring indicates little soil compaction or displacement occur when these conditions are met. Snow/frozen ground conditions rarely occur in Section A. In this section, potential soil damage will have to be weighed with other riparian resource concerns on a site-specific basis.

4. Road construction and reconstruction in riparian reserves should be avoided, except for restoration purposes (e.g. culvert replacement, waterbarring, etc.). Overall, decreasing road density in riparian reserves will reduce runoff and sediment loading. Appendix D lists roads recommended for closure.

5. Blowdown material on Fourmile Flat in Section A should be salvaged to lower fire hazard. Remaining fine fuels should meet but not exceed Forest Plan recommendations.

6f. In general, natural regeneration should be allowed to occur in riparian reserves, including the blowdown units in Section A, where sufficient cover to meet riparian reserve functioning is already developing. Planting using hand scalping may be beneficial on selected sites, to enhance species diversity or wildlife habitat.

7. Historical information, the functioning of the stream system, and recent events suggest Section A is subject to frequent disturbance. Suitable spotted owl habitat has been minimal during the past 50 years, and connectivity is interrupted by natural openings. It may be more logical to manage for a diversity of riparian habitats and wildland-rural interface concerns, rather than spotted owl habitat in this section.

8. Thinning followed by periodic prescribed fire could be used to restore mixed conifer stands in the riparian reserves of Section A to historical conditions, and maintain/develop large diameter pines.

9. Riparian reserves in Section B should be managed similarly to the rest of the LSR, as outlined in the LSR Assessment. The emphasis should be on maintaining NRF habitat over the long term.

10. The riparian reserves of logged-over tributaries in Section B should be further evaluated to determine if road closure and/or restoration opportunities are present. However, restoration of these tributaries will be a lower priority than restoration of fish-bearing streams.

11. It is likely that additional riparian areas will be found in the Lost Creek subwatershed (Section C) during project layout. Over snow/frozen ground may be a useful mitigation to protect areas with many unmapped small ephemeral streams and wetlands.

12. Initiating thinning treatments in lodgepole pine stands in Section C at this time could be used to slow mortality rates. This would reduce future fuels buildup, and limit firewood cutting and road creation. Continuity of fuels and access should be considered, prior to proposing treatments.

13. Conduct surveys for great gray owls using Regional protocol (scheduled to begin in 1996).

14. Maintain or enhance mature or old-growth lodgepole pine or mixed conifer stands within 1,000 feet of meadows (great gray owl habitat).

15. During management activities, large diameter snags (including broken top snags) and downed logs should be protected in riparian reserves to the extent feasible. Install nesting platforms where nest sites are deficient in great gray owl habitat.

G. Cultural Resources

1. Gather information with oral history interviews and archival research and validate this information with the archeological record. Validation should include an inventory of the railroad system and other historic sites so that the actual numbers of sites (and length of linear features such as railroads) and their conditions are known. Only from such an inventory can sound management recommendations be made.

2. Distinguish among sites created by different, though similar, activities such as camps generated by a working party versus those created by recreational hunters.

3. An analysis should be conducted to determine if the area constitutes an Historic District. The benefit of this designation would be that a specific management plan would then be developed, which would allow management decisions about site protection to be made programmatically, rather than on a site-by-site basis, as is currently practiced.

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APPENDIX A. LIST OF PEOPLE CONSULTED

Core Team
Sarah Malaby Terrestrial Ecologist/Botanist
Eddie OlmedoWildlife Biologist
Lindsey Pruyn-sitter Soil Specialist/Hydrologist
Sherry West Fish Biologist/Aquatic Ecologist

Agency Specialists
Lila Clanton GIS Specialist/WIN Inventory
Denny Edwards Reforestation Specialist
John Giller Fuels Specialist
Paul Im Recreation Planner
Phil Jahns Silviculturist
Rod JohnsonNEPA Coordinator
Pam MartinComputer Clerk
Ray McClenathan GIS Coordinator
Roberto Morganti Landscape Architect
Jeanie SheehanReviewing Editor
Chris Thompson Archeologist

Public/Other Agencies
Ron AnglinBiologist, Oregon Dept. of Fish and Wildlife
Craig Bienz Klamath Tribes Biologist
Larry DunsmoorKlamath Tribes Biologist
John FortuneBiologist, Oregon Dept. of Fish and Wildlife
Ralph OppRetired Biologist, Oregon Dept. of Fish and Wildlife
Roger SmithBiologist, Oregon Dept. of Fish and Wildlife

APPENDIX B. REGIONAL FORESTER'S SENSITIVE PLANT SPECIES LIST FOR THE WINEMA NATIONAL FOREST

SPECIES	STATUS	DOC. IN AREA?	POTENTIAL HABITAT	OCCURRENCE[1]
Botrychium pumicola	C1,OC	No	LP basins, high elev. slopes, pumice soils	Possible, in CLNP
Arabis suffrutescens var. horizontalis	OCNo		Gravelly, rocky, pumice slopes, high elevations	Possible, in CLNP
Astragalus peckii	OCNo		LP/bitterbrush openings, sagebrush, pumice soils	Unlikely, no habitat
Castilleja chlorotica	OCNo		Gravelly slopes/summits, PP/LP openings, 5000' +	Unlikely, not found on KRD
Collomia mazama	OC	Yes	Mesic LP & fir forests partial canopies, mid elev.	Cold Springs
Eriogonum procidiuum	OCNo		Volcanic slopes, basalt flows pine woodlands 4200-8200	Unlikely, not found on KRD
Mimulus pygmaeus	OCNo		Spring-wet depressions and flats, intermittent streambeds	Possible, tiny annual
Perideridia erythrorhiza	OCYes		Spring-moist meadows edge of mixed conifer forest	Pelican difficult to I.D.
Penstemon glaucinus	OCNo		LP/WF forests, high elevations	Unlikely, not found on KRD
Rorippa columbiae	OCNo		gravelly streambeds, lakeshores	Possible, hist. site
Asarum wagneri	OCYes		LP & fir forests, open canopies, rocky sites	Fourmile edge of range
Calochortus longebarbatus var. longebarbatus	OCNo		dry-moist meadows, edge of LP/PP woodlands	Unlikely, not found on KRD

in Sky Lakes

Eriogonum diclinum	Dry, rocky ridgetops, sandy-gravelly slopes & flats, serpentine soils	Unlikely, not found on WIN
Thelypodium brachycarpum	Sagebrush openings, meadows in PP forests, streamsides	Possible, hist. site
Allium bolanderi	Dry rocky or clay soils, openings in brush or woodlands	Unlikely, not found on WIN

B1

SPECIES	STATUS	DOC. IN AREA?	POTENTIAL HABITAT	OCCURRENCE[1]
Calliergon trifarium	No	Yes	Fens with standing water often submerged	Possible, at Bull Swamp
Cicuta bulbifera	No	Yes	Swamps, marshes	Possible, hist. site
Gentiana newberryi	Yes	Yes	Moist-wet meadows mid-high elevations	Cold Springs
Haplopapus whitneyi var. discoideus	No	Yes	Open, high elevation rocky slopes	Possible in Sky Lakes
Hieracium bolanderi	No	Yes	High elevation slopes in the Cascades	Possible in Sky Lakes
Mimulus jepsonii	No	Yes	Openings in LP/PP forests, residual soils, E. Cascades	Unlikely, not found on WIN
Mimulus tricolor	No	Yes	Moist flats, vernal pools, pools, wet clay soils	Unlikely, not found on KRD
Perideridia howellii	No	Yes	Moist slopes & meadows, streamsides	Unlikely, not found on WIN
Silene nuda ssp. insectivora	Yes	Yes	Spring-moist meadows low elevations	Pelican

C1 - Category 1 Candidate for Federal listing
OC - State of Oregon Candidate for listing
LP - Lodgepole pine
PP - Ponderosa pine
WF - White fir
CLNP - Occurs in Crater Lake National Park north of the watershed area.
KRD - Not found on the Klamath Ranger District to date.
WIN - Not found on the Winema National Forest to date.
Hist. Site - Historical Sighting on District or in nearby areas.
Sky Lakes - If present, most likely to occur in Sky Lakes Wilderness.

[1]Probability of occurrence in the watershed area, based on the known distribution and habitat requirements of species, past survey data, and the likelihood of detection of species during past surveys in the area.

Appendix C. ADDITIONAL WILDLIFE SPECIES INFORMATION

1. NORTHERN SPOTTED OWL

Approximately 20,258 acres of spotted owl Critical Habitat lie within the watershed area (Figure C-1). Of this, 10,639 acres are within LSR R0227. The remainder of Critical Habitat (9,618 acres) is within matrix lands.

Legal descriptions of activity centers in the North Fourmile Watershed are as follows: 1) T35S R05E Section 12 (#2752); 2) T35S R05E Section 26 (#2764); 3) T36S R05E Section 35 (#2238); 4) T35S R05E Section 25 (#1772); 5) T35S 06E Section 32 (#2760); 6) T34S R06E Section 04 (#2243); 7) T36S R05E Section 15 (#1783); and 8) T36S R06E Section 06 (#2755 Territory single). Activity center #2754 lies just outside of the North Fourmile boundary (T35S R06E Section 27). Four additional activity centers have home ranges which overlap with the watershed boundary (#1773, #2581, #1786, and #4176).

Five of the activity centers (#1783, #1772, #2760, #2755, and #2243) are in LSR, the rest in matrix. One hundred-acre cores (required for matrix) have been designated for each activity center. The core for activity center #2752 contains 24 acres of NRF habitat, 26 acres non-NRF dispersal habitat, and 50 acres of non-owl habitat. The core for activity center #2760 contains 92 acres of NRF habitat and 8 acres non-owl habitat. All other activity center cores are composed almost entirely of NRF habitat.

Calculations for NRF habitat within 1.2 miles and .7 miles of activity centers are shown below. Activity centers located outside of the watershed area, but with territories that overlap the watershed, are included.

NRF habitat was calculated as follows:

Activity Center	#within 1.2 mi	within .7 mi
1772	1682 ac	705 ac
1783	1689 (1288 ac +)	810 (702 ac +)
2243	1541	837
2755	758*	511
2760	1678	435**
2238	2022	805
2752	1141 (895 ac +)*	271 (268 ac +)**
2764	1157*	518
2754***	1789 (914 ac +)	762 (352 +)
1773***	1246 (13 ac +)	xxx (0 ac +)
2581***	1289 (232 ac +)	538 (1.4 ac +)
1786***	684 (165 ac +)*	363 (64 ac +)**

* Does not meet the minimum suitable habitat acres of 1,182 within 1.2 mi.
** Does not meet the minimum suitable habitat acres of 500 within .7 mi.
*** Activity center outside watershed but territory overlaps watershed.
(+) Amount of habitat acres within this watershed.

For more information on spotted owl habitat, see Gutierrez and Carey (1985), Johnsgard (1988), and USDI (1992).

C1

2. BALD EAGLE

Legal descriptions of the eagle nests are as follows: #570 is located in T35S R06E Section 34, and #527 is located in T36S R06E Section 4.

Territories #570 (previously #604-150) and #527 (previously #028-107) are both located in the Fourmile Creek subwatershed. In 1995, territory #570 produced and fledged 2 young. Territory #527 was not occupied in 1995.

For more information on bald eagle habitat, see USDI (1986 and McGarigal et al. (1991).

3. NORTHERN GOSHAWK

Based on wildlife habitat modeling using PMR data, approximately 8,272 acres of primary goshawk habitat are estimated to occur within the North Fourmile area (Figure C-2). Goshawk habitat has a distribution similar to spotted owl NRF habitat. Fragmentation is apparent, but continuous habitat does extend from just southeast of Fourmile Lake, running north and northeast into the Lost Creek subwatershed, and then north into Sky Lakes Wilderness. Habitat is lacking in the southwestern portion of Fourmile Creek above Seldom Creek subwatershed, southern portion of the Fourmile Creek subwatershed, and the southern and northcentral areas of the Lost Creek subwatershed.

Formal surveys/inventories have not been conducted for northern goshawks on the District. Approximately 10 sightings of goshawks in the North Fourmile area have occurred since 1988, with 6 occurring since 1992.

Legal descriptions of the above goshawk sightings are as follows: T35S R05E Section 14 (1988); T35S R05E Section 35 (1990); T35S R06E Section 34, T35S R05E Section 23, (1991); T36S R06E Section 7, T36S R05E Section 16, (1992); T36S R05E Section 15, T36S R05E Section 1, T36S R06E Section 4, T35S R05E Section 12 (all 1994). Territories have not been identified but it is possible that 4 to 6 territories exist within the North Fourmile area.

For more information on goshawk habitat, see Austin (1993) and Marshall (1992).

4. BLACK-BACKED WOODPECKER

Currently, habitat for this species can be found throughout the watershed. Areas with lodgepole pine, ponderosa pine, and mixed conifer provide suitable nesting and foraging habitat. Stands along the meadows near Pelican Barn and other riparian systems presently contain good habitat. Based on PMR habitat modeling, black-backed woodpecker secondary habitat totals 6,440 acres (Figure C-3). No primary habitat was found based on this model; however, it is likely that the lack of primary habitat represents an inaccuracy in the model.

Formal surveys have not been conducted for this species in the watershed. However, four sightings of black-backed woodpeckers have been recorded for the North Fourmile area. Sightings of this species within the watershed are as follows: T36S R05E Section 8 (1990 & 1992); T36S R05E Section 13 (1990); and T36S R05E Section 14 (1990).

For more information on black-backed woodpecker habitat, see Marshall (1992).

C2

5. PYGMY NUTHATCH

Based on wildlife habitat modeling, approximately 620 acres of pygmy nuthatch primary habitat currently exist within the lower elevations of the watershed (Figure C-4). Much of the habitat overlaps with the LSR. Habitat is fragmented; patches are distributed in the southeastern portion of the Fourmile Creek above Seldom Creek subwatershed, southeastern portion of the Lost Creek subwatershed, and the southern portion of the Fourmile Creek subwatershed.

Relative abundance of the species in the North Fourmile area is unknown. Sightings of pygmy nuthatches have not been recorded for this watershed, even though the species is likely to occur.

For more pygmy nuthatch habitat information, see Marshall (1992), Ehrlich et al. (1988), and Gilligan et al. (1994).

6. FLAMMULATED OWL

Based on PMR habitat modeling, flammulated owl primary habitat is estimated at 1,147 acres (Figure C-5). The model indicates primary habitat is similar to that of the pygmy nuthatch.

No formal surveys have been conducted for this species on the District. Sightings have not been recorded in the North Fourmile area; however, flammulated owls have been observed 1-2 miles outside of the watershed boundary, and it is likely that they are present inside the boundary as well.

For more habitat information, see Marshall (1992), and Hayward and Verner (1994).

7. WHITE-HEADED WOODPECKER

White-headed woodpecker is expected to be similar to pygmy nuthatch and flamulated owl habitat.

No formal surveys have been conducted for this species on the District. Three sightings of white-headed woodpeckers have been recorded in and near the North Fourmile area. Legal descriptions of the sightings are as follows: T35S R06E Section 33 (1990), T36S R06E Section 9 (1991 & 1993). The 1991 and 1993 sightings were outside the North Fourmile boundary.

For more information on white-headed woodpecker habitat, see Dixon (1995), Milne and Hejl (1989), and Marshall (1992).

8. PACIFIC FISHER

Fisher habitat is present within all of the forest zones. Logging of mature to old-growth forests and riparian systems and reduction of canopy closure and large down woody debris could have decreased the quality of fisher habitat in some areas. Fragmentation of forests could also have adversely Affected this species. However, trapping probably had the largest impact on the abundance and distribution of fishers, and may have even removed them from the North Fourmile area.

C3

No surveys have been conducted on the District. Sightings have not been documented within the North Fourmile boundary, but fishers have been observed on Mt. McLoughlin (T36S R04E Section 14 by Craig Bienz, Klamath Tribes biologist) and north of Cold Springs (1995).

For habitat information, see Marshall (1992), USDA (1994), and Heinemeyer and Jones (1994).

9. AMERICAN MARTEN

Logging has reduced the amount of late successional and old growth habitat, particularly in the white fir zone. However, logging has also created habitat components, such as cull decks and slash piles.

Surveys for martens have not been conducted on this District. However, this species has been documented 7 times within the watershed. Legal descriptions of the above marten sightings are as follows: T35S R05E SEC 12 (1982; 1993), SEC 23 (1989), SEC 25 (1989), SEC 36 (1983), T35S R06E SEC 34 (1993), and T36S R05E SEC 9 (1985).

For more information on marten habitat, see Marshall (1992) and USDA (1994).

10. GREATER SANDHILL CRANE

The amount of sandhill crane habitat in the watershed area has decreased slightly due to fire suppression and lodgepole pine encroachment in meadows. Channelization and grazing of the meadows in the lower Fourmile watershed may also have affected habitat quality. Birds may also be disturbed by recreationists using off-road vehicles in the meadows during the nesting season.

Surveys have not been conducted for sandhill cranes. Five sightings have been recorded in the North Fourmile area. Legal descriptions for the sightings are as follows: T36S R06E Section 3 (1994), and Section 9 (1995 and 3 in 1993). Nesting has not been recorded.

For more habitat information, see Johnsgard (1983) and Littlefield and Paullin (1990).

11. BATS

Structures at Pelican Barn and bridges may provide habitat. In 1994, bat surveys were conducted on the District, including a site near Lost Creek at the junction with Forest Road 3651 in Section 26. Five species of bats were captured at this site: big brown bat, silver-haired bat, hoary bat, California bat, and Yuma bat.

Few studies have been done on bat species in the Pacific Northwest. Biologists suspect that bat populations have been declining in recent years (Christy and West, 1993). Some of the species listed above may overwinter in the watershed. None of the species are classified as federally protected.

For more information on bats, see Christy and West (1993), and Cross and Kerwin (1995).

12. NEOTROPICAL MIGRATORY BIRDS

This group of birds is receiving attention because of evidence of downward population trends throughout the country. However, research is still lacking in the Pacific Northwest. According to Andelman and Stock (1994), eastern Oregon old-growth coniferous forests appear to be one of the most vulnerable habitats during the next half century. Wet and dry meadows, aspen groves, and freshwater marshes, lakes, and ponds were considered moderately vulnerable.

Twenty-six NTMB species in Oregon are known to have experienced long-term declines (Andelman and Stock 1994). Some of these species occur within this watershed, including Williamson's sapsucker, olive-sided flycatcher, barn swallow, Wilson's warbler, and western wood-peewee.

Habitat conservation priorities have been developed with recommendations for management and conservation of these habitats. Habitats included in these priorities include eastside old-growth/mature coniferous forests, and riparian zones.

Surveys for NTMBs have not been conducted on the District.

For more information on NTMBs, including species that may occur within this watershed, and habitat associations, see Andelman and Stock (1994), Ehrlich, et al (1988), Gilligan et al. (1994), Martin and Finch (1995), and USDA (1993).

C1

C2

C3

ID#LOCATIONPROJECT DESCRIPTION

3114E3659-290close/oblit, waterbars, rehab landings
3115E3659-295close/oblit, waterbars
3116E3659 @ 290 Jxnclose/oblit, rehab landing
3117E3659culverts, ditchwork, road grading
3118E3659-080close/oblit
3119E3659-unnamed spur close/oblit/rehab - rec. site
3120W3659 Fordimprove/rehab
3121W3659trailhead parking erosion control
3024E3651-980waterbar
3025W3651 creek access, close/oblit/rehab
3122E3651replace/relocate culvert
3123W3651unnamed spursclose/oblit - rec. sites
3124E3651-760rehab landings and short spurs, waterbar, close/oblit?
3125E3651-761waterbars, close/oblit?
3126E3651-762waterbars, close/oblit?
3127E3651-763close/oblit
3128W3651relocate culvert, bank repair
3129W3651relocate culvert, bank repair
3130W3651fix culvert, channel repair
3131E3651culverts, road maintenance, channel repair
3132W3651-290close/oblit, channel repair
3133E3651-270close/oblit
3134W3651 rehab, erosion control - rec sites
3135W3651-spur;bridge close/oblit;rehab tractor crossing at bridge
3136E3623close/oblit 090, culverts, waterbars
3137E3455erosion control