INTERPRETATION

CHAPTER IV

INTERPRETATION

This chapter is a synthesis and interpretation of the information presented in previous sections. It specifically resolves or interprets the importance of differences or similarities between current conditions and reference conditions, and gives some indication of current use and resource trends. This interpretation is presented by Issue and Key Questions, as presented in Section III of this analysis and constitutes the answers to the Key Questions.

ISSUE #1

INTENSITY AND PATTERN OF VEGETATION MANIPULATION RELATED ACTIVITIES

Timber harvesting has essentially replaced wildfire as a regenerative force in this watershed. The gross amounts of early, mid, and late-successional habitat have not changed appreciably as the result of this replacement but the configuration and distribution of these types of habitat have changed dramatically. Abundant late-successional habitat exists in the high elevation, eastern portion of the watershed where historically fires burned relatively frequently. In the lower elevation western portions, where stand replacement events were relatively few, far between, and small, harvesting has greatly reduced late-successional habitat and to a large extent fragmented that which remains.

Projecting current management into the future results in a continuation of habitat fragmentation in the relatively small area available for harvesting, primarily because restored riparian reserves will provide for abundant edge habitat. In the bulk of the watershed (the LSR and other non-harvest allocations) unfragmented late-successional habitat will slowly increase as young stands created by past harvest mature. Habitat connectivity will improve as harvested riparian stands mature.

The intensity of past harvest has likely increased the frequency of peak flow events and contributed to elevated sediment levels in streams during high water, though road related sources probably contribute more sediment per area based on the proportion of the land that roads occupy.

Issue #1 Key Questions

QUESTION 1:

> Given current land allocations in the Willamette Forest Plan, as amended by the Northwest Forest Plan, what is the location and acreage of areas that are available for regeneration harvest for the next two decades and for commercial thinning, by decade, for the next 50 years?

Regeneration harvest opportunities are primarily limited to Blair Lake Basin and Cupit Mary Flats over the next few decades, due to recently planned harvest projects and resource conditions. Approximate acres available for regeneration harvest in the next two decades are as follows: 6400 acres in subwatershed 18 1, and 2850 acres in subwatershed 18 2. Subwatershed 18 3 is almost entirely within the Late-Successional Reserve and the Waldo Wilderness Area.

Approximate areas available for commercial thinning, by decade, for the next 50 years, are as follows:

In Late-Successional Reserve:
1995-2005: 1030 acres on lower Mule Mountain and lower portions of Kelsey and Warble Creeks
2005-2015: 3600 acres across the entire LSR
2015-2025: 2900 acres across the entire LSR
2025-2035: 3700 acres across the entire LSR
2035-2045: 360 acres widely scattered in Ranger, Furnish, and Black Creek drainages

In Matrix:
1995-2015: 1100 acres on the south slopes of Dead Mountain and Huckleberry Mountain and the north slopes of Squaw Butte.
2015-2045: 4550 acres widely scattered in subwatershed 18 1, 470 acres in subwatershed 18 2.

QUESTION 2:

How has the intensity and pattern of vegetation manipulation affected native and non-native plant and animal habitat diversity, species composition, guild viability, amount of interior habitat, and habitat connectivity?

TERRESTRIAL WILDLIFE

INTERIOR FOREST VS. EDGE HABITAT - EFFECT ON HABITAT DIVERSITY AND FAUNAL SPECIES COMPOSITION

As timber harvest strategies were applied in the watershed, the overall abundance of late seral and old-growth habitat decreased and the size of retained habitat blocks was reduced as forest fragmentation progressed. Just as edge habitat increases with moderate levels of fragmentation, interior habitat decreases. As previously described (Chapter III), this has likely resulted in a shift in the biotic community as less, high quality interior late seral forest habitat and a more fragmented forest with early to mid seral habitat became available. These landscape trends result in a decrease in large home range mosaic species and an increase in small home range guilds and contrast species of all home range sizes. Generalist species of all home range sizes likely gained occupancy to areas as they became less suitable for species that select for large blocks of interior habitat. These effects have reduced the capability of the late-successional reserve within this watershed to meet management objectives for the LSR. Currently 10% of the spotted owl activity centers in the LSR (and also 10% of all activity centers in the watershed) have home range conditions below 40% suitable habitat. Under the Willamette Forest Plan as amended by the ROD, late seral habitat conditions in the LSR should improve over time.

As described in the Current Condition section of this document, forest fragmentation has played a significant role in development of edge habitat within the watershed. A comparison of seral stage maps (Figures 28 and 29 on pages 48 and 49 of the Reference/Current Condition chapter) reveals the distribution and amount of edge habitat has disproportionately increased in the western two-thirds of the analysis area, and the average patch size is small relative to reference conditions. This trend may have resulted in a shift in the biological community, with a decrease in medium and large home range patch (e.g. rosy finch) and mosaic species (e.g. spotted owl and fisher), and an increase in small home range guilds and contrast species (e.g. mountain blue birds, California quail, and elk) of all home range sizes. This condition has resulted in higher populations of elk and deer than existed prior to timber harvest activity.

On the eastern one-third of the watershed, forest fragmentation has been less prevalent and relatively more late seral and old-growth habitat is present than in the reference example (compare Figures 28 and 29 on pages 48 and 49 of the Reference/Current Condition chapter). This has occurred as fire regenerated stands matured in the absence of intensive timber harvest or repeated large scale and frequent fires. Though it is difficult to speculate on how intensive and extensive fires might have been had they not been suppressed, it is possible that fire suppression may have contributed to the development of more late seral habitat in these areas than what existed 75 years ago. The result of having large tracts of timber maturing into late seral and old-growth forests is a shift in the biotic community from early and early-to mid-seral habitat users to mid-to-late seral and old-growth habitat users. This effect has increased the capability of portions of this watershed in LSR0220 to contribute to meeting long-term management objectives for LSRs. However, much of this area (and other portions of subwatersheds 18 2 and 18 3) that has matured into late seral and old-growth habitat is not within the Douglas fir/western hemlock plant associations most suited to spotted owls, but is within the true fir/mountain hemlock plant associations best suited to a host of other species.

The trend in edge habitat increasing with forest fragmentation is expected to plateau and then decline as late seral and old-growth forests continue to be removed in General Forest (matrix) under an 80 year rotation or in Scenic Partial Retention under a 100 year rotation where stands will not have the opportunity to return to late seral conditions. This scenario of edge habitat limitations is also expected to occur in the LSR as early and mid-seral stands mature since regeneration harvest (establishment of early seral habitat) no longer occurs in this area. Exceptions to this trend may be for small home range species which have relatively small minimum patch sizes and may be provided suitable habitat by prescriptions for timber harvest in matrix, and for areas of the watershed where high densities of riparian reserves will provide the late seral component of edge habitat along harvested stands in matrix. Though edge habitat may generally decrease across the landscape over time, edges would be concentrated along riparian reserves, along supplemental and larger LSRs, and occasionally along stand replacing disturbance patches within the larger LSRs.

As described above, habitat for edge dependent species has historically been on the increase within most of the watershed. The vegetational elk habitat effectiveness has increased over time for much of the watershed in response to arrangement of timber harvest units which strategically placed forage blocks in proximity to cover blocks. The exception to this is in areas that have been treated with large blocks of intensive harvest with little interspersed cover (such as Dead Mountain) or in areas where harvest has not occurred and successional development has affected historic forage/cover ratios.

Large home range generalist species such as the gray wolf and a sub-species of grizzly bear known as the Klamath grizzly were inhabitants of this watershed during the reference era. Although large home range generalist habitat is currently abundant, these historical inhabitants are absent from the present landscape. The Klamath grizzly was extirpated from the Cascades in the 1930's and is considered extinct. The gray wolf was declared extirpated from this portion of its historic range in the mid 1940's, however occasional reports of the presence of wolf-like canids in this watershed persist into the 1990's.

Two additional threatened or endangered generalist or special habitat species guild representatives of note that presently occupy habitat within this watershed are the bald eagle and peregrine falcon. Portions of three peregrine falcon nest site management areas (PFMA) exist within the watershed. The actual nest site for one of these areas (OE-36) is located in the watershed, with 84% of the PFMA within the watershed boundary. The other two nest sites, OE-30 and OE-22, are outside the watershed with 41% and 8% of the PFMA's located within this watershed boundary respectively. Fire history has variably affected the landscape within, and past harvest activity has influenced the condition of the PFMA's. Present land use allocation differs greatly between PFMA's with OE-36 situated entirely within LSR0220, and OE-30 and OE-22 falling under mostly matrix, scenic, or riparian reserve allocations.

Resource concerns with respect to these areas focus on the potential for noise disturbance to peregrines from management activities during the nesting season (January 1 through July 31), and that management proposals within PFMA's recognize and address the needs of peregrine falcon prey species. Management plans should be completed for PFMA's and used to guide activities proposed within these areas.

Most (67%) of a bald eagle management area (BEMA) is also located in this watershed. This represents 140 acres, all of which are under wilderness allocation. Management concerns with respect to this area focus on the potential for disturbance to eagles from recreation activities, and the potential for wildfire to impact bald eagle nesting habitat.

HABITAT STRUCTURE

Approximately 8,900 acres (11% of the watershed) were intensively harvested prior to 1970. On these areas snag levels may be variable, but are generally well below the average natural range. Down woody debris may be abundant, but in some areas (Dead Mountain burn for example) much of the larger pieces are likely to be in advanced stages of decomposition. In these areas large woody debris levels are also likely well below the natural range between the time existing logs decompose and existing regeneration stands begin contributing large woody debris to the forest floor. As a result, species that utilize snags and down logs as habitat may become less locally abundant until new snags and down wood become available for use. In other areas, very large logs were left during initial harvest operations, and given comparable environmental conditions, these logs will continue to provide suitable habitat for many species that utilize log habitat over a much longer period of time than would smaller logs of the same tree species.

Approximately 14,100 acres (17% of the watershed) were intensively harvested during the 1970's and 1980's. These areas generally have low levels of both snag and large woody debris as a result of higher utilization standards and unmerchantable log-yarding requirements that were employed during that period. These areas are below natural levels for these habitat components and will continue to be below natural levels until new snags and down wood become available for use. Thirteen percent of the 53% of the watershed affected by stand replacement fire in the past two centuries contained residual trees. Where these residual trees still exist, they will serve an important role as a future source of large snags and down wood in younger stands.

Though approximately 1,300 acres (1.6% of the watershed) have been harvested between 1990 and present, many of these acres included prescriptions that were in place prior to 1990 and the adoption of the current Forest Plan as amended by the ROD. As a result, these areas may also be below natural levels of snag and large woody habitat. For sales implemented under recent prescriptions the trend is for wildlife trees to be generally smaller than what was left prior to 1990 though numbers of snags retained is generally

higher. Smaller snags and logs will not persist as long and will not accommodate cavities as large as, or retain temperature and humidity as well as those with larger diameters. Thus the trend toward leaving smaller wildlife trees has resulted in habitat that will not provide for all cavity dwelling species (e.g. pileated woodpeckers and colony nesters). This habitat may not be as effective in providing shelter to temperature and humidity sensitive species (e.g. Oregon slender salamanders and ensatina salamanders), and will not provide habitat as long due to more rapid decomposition. Species that utilize snag and down wood habitat during reproduction are listed in Appendix A.

CONNECTIVITY / DISPERSAL

As Figure 13 in the Reference/Current Conditions chapter shows, many potential connective corridors associated with riparian reserves have been exposed to habitat altering activities. This decreases their ability to provide suitable linkages between various portions of the landscape for some species of plants and animals. Previously harvested areas within riparian reserves may not moderate solar radiation, temperature, and humidity as much as mature stands or may not provide enough cover to allow successful movement through these areas or across the landscape by some species. Stand connectivity provides for genetic exchange in species that do not migrate. Without adequate connectivity of suitable habitat across the landscape populations may become isolated. Isolated populations may ultimately be detrimentally affected by genetic drift.

Areas within this watershed where connectivity habitat has been most affected by harvest activity include portions of subwatershed 18 3 along stretches of Furnish and Mule Creeks, and portions of 18 1 along Trapper Creek, Wall Creek, and in numerous riparian areas on Squaw Butte and Dead Mountain. Table 48 in the Reference/Current Conditions chapter shows that overall 33% of the riparian reserve acres in LSR0220 have been harvested and 23% of the remaining riparian reserves in general forest have been harvested. Forty-three percent of the wilderness acres within this watershed are intact lake or stream riparian reserves.

Upland portions of the watershed also provide important connective habitat, especially when located along ridges, in saddles, or on topographic benches. Table 48 in the Reference/Current Conditions chapter shows that 30% of the upland acres in LSR0220 have been harvested and from Table 49, also in the Reference/Current Conditions chapter, it can be seen that 42% of the acres available for harvest are presently 0 to 80 year old stands. Fifty-seven percent of the wilderness acres within this watershed provide higher elevation upland connectivity of mostly true fir/mountain hemlock plant association habitat.

The westward extension of this higher elevation true fir/mountain hemlock habitat along Mule Mountain and Bunchgrass Ridge has experienced some shifts in seral stage composition from reference conditions. Some areas of Mule Mountain have matured into late seral stands while at about the same rate, early seral stands have been created as a result of harvest activity. Much of the later seral stage acres along Bunchgrass Ridge have shifted into early seral conditions due to harvest activity and effects of the Warner Creek fire.

Within the LSR, both riparian and upland habitat connectivity should recover and improve in the long term under present management direction. Connectivity habitat in General Forest portions of the watershed should recover and improve within riparian reserves and upland areas that have been included in supplemental LSRs.

Table 1 displays the condition of the USFWS designated CHU (OR-19) within this watershed that is located outside LSR0220 and currently under harvest allocation. Seventy-four percent of these total acres are presently stands greater than 80 years old and serve as no less than dispersal habitat for northern spotted owls.

Table 1: Current Condition of CHU (OR-19) Acres Under Harvest Allocation

Subwatershed	Total Acres	SRI Unsuited	Seral Stage			
			SI	SE	UR	LS/OG
18 1	2,114	199	543	210	829	332
18 2	3,537	323	438	157	1,833	785
18 3	103	19	19	0	5	59
Total	5,754	541	1000	367	2,667	1,176

Legend: SRI Unsuited = acres on soils unsuited for harvest activity
SI = acres in stand initiation (0-30 year old stands)
SE = acres in stem exclusion (31-80 year old stand)
UR = acres in understory reinitiation (81-200 year old stand)
LS/OG = acres in late-successional/old-growth (200+ year old stand)

On the landscape level, potential linkages between LSRs 0220, 0219, 0221, and 0222 are now, and should continue to be, best provided through riparian connectivity. Upland habitat connectivity may become compromised for some species under management of harvest allocation lands. Though this may not impede genetic exchange between more mobile species such as owls, goshawks, and pileated woodpeckers, it may reduce genetic exchange between less mobile species that rely on habitat characteristics not present in managed stands.

Analysis for dispersal habitat for northern spotted owls (50-11-40) may also have applications to other species that have good mobility, but that require visual cover, short term foraging habitat and some climatic moderation while moving across the landscape. Review of 50-11-40 analysis for this watershed indicates that all quarter townships are near to well above the level considered to be adequate to provide for dispersal of northern spotted owls. The three quarter townships with the lowest values are all within the LSR. In LSRs low levels of dispersal habitat, like low levels of suitable nesting or foraging habitat, compromise the capability of the LSR to function for its intended purpose. However, the values range from -2 to +8 from the 50-11-40 threshold and should continue to improve under present management guidelines for LSRs.

NON-NATIVE SPECIES

A variety of non-native animal species presently occur within this watershed. As discussed in Chapter III, the level to which these species have established populations and the overall effect they may be having on native species is not known. The barred owl is presently recognized as the only non-native terrestrial wildlife species of concern. The primary concerns are the known displacement and suggested potential for genetic dilution of spotted owl populations by barred owls.

PLANTS

NATIVE AND NON-NATIVE HABITAT DIVERSITY; INTERIOR HABITAT; CONNECTIVITY; SPECIES COMPOSITION; VIABILITY

Late-successional species habitat in the watershed has declined due to extensive harvest of old-growth stands and associated road building. Remaining old-growth in the watershed is concentrated at higher elevations and is in some cases highly fragmented. Many survey and manage species have limited dispersal capabilities, thus in fragmented habitat areas geneflow may be restricted between populations. Single species management after harvest in riparian forests along with adjacent upland stands has contributed to a simplification of species richness in plant communities.

Management activities have over time accelerated the spread and establishment of non-native vegetation that can aggressively outcompete native species. Clear cuts and other disturbed openings are sites where invasion is rapidly occurring by noxious weeds and other non-natives. Scotchbroom is an example of such spread.

Though the extent of effects of previous management activities on special habitats is not well documented at this time, a number of specific cases are known. Many sites have been altered, degraded or created by past management actions. In some areas intensive timber harvest has been implemented up to the edges or across special habitat areas; quarry activities have altered rock habitats.

QUESTION 3

How has the intensity and pattern of vegetation manipulation affected trails, recreation, aesthetics, special forest products, and firewood availability?

TRAILS

Hiking trail mileage has been reduced over the past 50 years.

RECREATION

Recreation opportunities related to roads, such as driving forest roads for pleasure, have increased. Non road related recreation opportunities on the other hand have decreased as a result of the road building related to vegetation manipulation. Big game populations are larger due to increased forage quantity and quality resulting in hunters having a better chance of a successful hunt.

AESTHETICS

Most people feel that vegetation manipulation has reduced aesthetic value of the landscape.

SPECIAL FOREST PRODUCTS AND FIREWOOD

Road building associated with timber harvesting has over time allowed easy access to forest plant communities containing desirable products for collection, including beargrass and firewood. Vegetation management activities has enhanced the production of products such as huckleberries.

QUESTION 4:

Where and to what extent has the change in spatial and temporal distribution of vegetation influenced the potential for water yield, water quality (especially water temperature), and peak flow changes?

WATER YIELD

Water yield has varied over time due to changes in the vegetative condition as a result of wildfire and timber harvest. During periods when large portions of the watershed were in early-successional conditions, water yield was likely higher due to a short term decrease in evapotranspiration. Due to the limited water storage capacity of lands within water yield Classes II and III, land types with high proportions of these classes would have a lower ability to store additional soil water input as a result of reduced evapotranspiration that would result from a wildfire event or timber harvest. All three subwatersheds have the highest proportion of their area in water yield class III.

Timber harvest in small watersheds has been shown to result in higher annual water yields. In two small watersheds logged in the H.J. Andrews Experimental Forest, annual water yield increased the most in the clearcut watershed. In the first year after logging, water yield increased 27 percent and averaged 30 percent over the first four years in the clearcut watershed (Harr et al. 1982). A decreasing trend in annual water yield will occur as the watershed is reforested. Harr (1983) estimated that after 27 years the increase in water yield from small watersheds will no longer be apparent.

In the case of large watersheds, it is likely that increases in water yield due to timber harvest does occur however it cannot be quantified due to the measurement error associated with discharge measurements from large watersheds. Harr (1983) estimated that a 70 year rotation on all commercial forest land in western Oregon would result in a six percent increase in water yield. Measurement errors on large watersheds however are generally on the order of 10 percent.

Within the Salmon Creek watershed, management impacts on water yields would be expected to be highest following periods when relatively large portions of the watershed were clearcut harvested, particularly in those portions of the watershed with a low water storage capacity. Annual water yield from the Salmon Creek watershed probably increased from approximately 1960 to the mid 1980's as the total number of acres of clearcut harvesting increased. Currently annual water yield is likely to decrease when compared to the previous two decades due to the reduced rate of stand replacement timber harvest.

PEAK STREAMFLOW

Aggregate Recovery Percent (ARP) values are a method of quantifying the potential for an area to experience increases in peak streamflow as a result of changes in vegetative condition due to management activities combined with rain-on-snow events. Those areas with the lowest ARP values would be associated with areas most likely to have increased peak flows. Current ARP values by subwatershed are listed in Table 7 of the Reference/Current Conditions chapter. Because roadside ditches function as extensions of the intermittent stream network, those areas with a high road density are more susceptible to management related increases in peak flows. Those planning subdrainages with a high proportion of their area within the transient snow zone combined with high road densities may be particularly sensitive to this effect (see Appendix D for a summary of road densities by subwatershed and planning subdrainage).

All subwatersheds are currently above a weighted mid-point ARP value based on Forest Plan values for planning subdrainages and weighted by area that each contributes to the subwatershed. Although subwatershed 18 1 currently has a relatively high ARP value, it would have highest potential for increases in peak flows associated with management. This area is predominantly within the transient snow zone, has a relatively high stream and road density, and has experienced, and will likely continue to experience the greatest portion of timber harvest within the watershed. Planning subdrainages of highest concern are those at or below the mid-point ARP value. Planning subdrainages in this category include 184 and 18u.

WATER QUALITY

STREAM TEMPERATURE

Stream temperature data collected in Salmon Creek at river mile one indicates a trend of increasing stream temperatures during the 1960's and continuing through the 1970's. Data collected since 1981 indicates that maximum stream temperatures have decreased when compared to the two previous decades. Temperatures within the lower mainstem of Salmon Creek however remain somewhat elevated above the relatively cool temperatures observed during the reference time period.

The lower mainstem of Salmon Creek from the mouth to approximately river mile ten currently does not meet the state water quality standard for temperature during at least some portion of the critical summer season (June 1 through September 30) of most years. From the mouth to headwater reaches, stream temperatures gradually become cooler. Available data indicates that above river mile ten, it is likely that summertime water temperatures are maintained below the maximum state water quality standard

The Willamette National Forest Land and Resource Management Plan (USDA, 1990) includes the objective of improving water quality within the Salmon Creek watershed. Specifically, Standard and Guideline MA-15-07 directs that summer water temperatures be maintained or reduced to below 70 degrees Fahrenheit by 1995 and to 67 degrees Fahrenheit by the year 2000. Available data indicates that continued reductions in maximum water temperature values would be necessary to reach the Forest goal for the year 2000.

Field data collected by the USFS indicates streams tributary to the mainstem of Salmon Creek are within state water quality standards for temperature. Brief or localized exceptions to this are likely associated with stream reaches still recovering from past management impacts or wildfires. Given the current standards for riparian area protection, it is likely the trend in the mainstem of Salmon Creek and its tributaries recovering from management activities will be in the direction of cooler summertime water temperatures.

STREAM TURBIDITY

Turbidity levels in streams have increased above natural levels in the lower portion of the Salmon Creek watershed (subwatershed 18 1) due to management activities including timber harvest, road construction and use, and removal of large woody material from stream channels. These activities have increased the frequency of landslides which deliver sediment to stream channels and in some cases have increased streambank and bed erosion. Chronic sediment source areas likely contributing to increases in stream turbidity are those areas where management has impacted areas of active or currently stable land flows composed of soils with a high clay content. Additional source areas of turbidity are existing management related landslides (Figure 5 of Reference/Current Condition chapter). The planning subdrainages with the highest number of road related landslides are 18Z, 181, 182, and 183.

QUESTION 5

What are the most important delivery mechanisms for sediment generated by vegetative manipulation in this watershed? What are relative amounts of sediment delivery to streams by these mechanisms? Where are the high risk areas?

Delivery Mechanisms

- Landflows primarily located in subwatershed 18 1 are primary locations for delivery of fine sediments. (i.e. streams cutting land flow toe slopes)
- Steep, shallow soils (many areas across watershed but mostly in 18 2 and 18 3) are locations for potential sources of course sediment (debris torrents).
- Maps of high risk areas are located in the Reference/Current Condition chapter, Figures 3 and 4.
- See narrative in Reference/Current Condition chapter for discussion of important sediment delivery mechanisms.

The rate of sediment yield for individual tributary areas has varied depending on the fire history, hillslope processes, landtype and channel type. During the pre-management time period, increases in sediment yield rates can likely be associated with large unstable land forms, fire activity, and floods. Large fires coupled with steep topography resulted in increased sediment delivery to stream channels.

During the post-management time period, sediment yield has increased due to management impacts combined with fire and flood events. Those tributary areas that have a relatively high natural instability

combined with moderate to high roading density and harvest impacts are the greatest current sediment sources.

Shallow mass soil movement, usually referred to as "debris torrents" and "debris slides", are the typical delivery mechanism for large amounts of sediment to the stream network. These events often occur in unmanaged forests but are accelerated by reduction of rooting strength due to harvesting and, more typically, by road construction and road related disruption of drainage patterns and sub-surface water flow. Road drainage entering the stream network is a more chronic source of sedimentation and may, over time, contribute more fine sediment than do debris torrents.

The areas of highest risk of becoming sediment source areas are identified as soil category 1 (fine sediment) and soil category 3 (coarse grained sediment), and are displayed in Current/Reference Condition Figures 3 and 4 respectively. Other high risk sediment source areas are those mid-slope roads on slopes greater than 40 percent and existing mass wasting sites (see Reference/Current Condition Figure 5).

QUESTION 6

Where and to what extent has removal of existing and future sources of large wood material in stream channels affected in-stream habitat condition? Where and to what extent has vegetation manipulation affected channel function and riparian habitat condition and its contiguity?

See the answer to question 4 under Issue #1.

Large woody material is an important component of most streams within the Salmon Creek watershed. Large wood provides cover for fish and amphibians; creates large pools; and stores and sorts sediment, increasing the availability and quality of spawning gravels. It contributes to stream bank stability and the retention of smaller sized organic materials used as a food base for macroinvertebrates. The rooting strength of vegetation along stream banks is an important component contributing to bank stability, especially where stream banks are composed of unconsolidated materials. Those riparian areas associated with streams that have experienced the greatest amount of harvest impacts are the areas of highest concern. Streamside vegetation also contributes to stream channel function and condition, by supplying fine organic material to the stream channel. The input of small to fine sized organic material is an important component of a healthy, functioning aquatic ecosystem. The riparian vegetation component that would require the longest time to recover from timber harvest related impacts is the supply of large woody material (LWM) to the stream channel. Large conifers are the most important source of large wood since they decompose slowly and can benefit the stream channels for a longer time than do hardwood species.

The majority of timber harvests within riparian reserves occurred between 1960 and 1989. The riparian reserves that experienced the largest amount of stand replacement harvest are those associated with Class IV streams. Table 2 displays the harvest by subwatershed and decade.

Table 2: Harvest by Subwatershed and Decade

Decade	SUBWATERSHED 18 1 % of Total Harvest Acres in Riparian Reserves		SUBWATERSHED 18 2 % of Total Harvest Acres in Riparian Reserves		SUBWATERSHED 18 3 % of Total Harvest Acres in Riparian Reserves	
	Acres	Percent	Acres	Percent	Acres	Percent
< 1929	195	4	0	0	0	0
1930-39	0	0	0	0	0	0
1940-49	152	3	0	0	0	0
1950-59	413	9	45	4	137	9
1960-69	1,388	31	337	29	527	33
1970-79	1,438	32	431	37	361	23
1980-89	831	19	303	26	511	32
1990-95	36	1	64	5	40	3

The streams in subwatershed 18 2 are currently the most deficient in large woody material with none of the surveyed stream reaches meeting current Willamette National Forest (WNF)objective amounts (see Reference/Current Conditions). Subwatershed 18 3 has the highest percentage of streams meeting current

WNF objective values. All of the subwatersheds will take many decades to recover the number and sizes of woody material within stream channels as existed under pre-management conditions.

Past management activities such as logging without leaving a riparian buffer, salvage logging adjacent to the stream channel, and stream cleaning projects have reduced the amount of large wood in the stream channels of the Salmon Creek watershed to levels below objective values and reference conditions (Table 3).

Table 3: Percent of Subwatershed Not Meeting Objective Values for Large Woody Material

Subwatershed	Total Stream Miles Surveyed	% Of Streams Not Meeting WNF Plan LWM Objective Values
Lower Salmon Creek (18 1)	12.1	82.7%
Black Creek (18 2)	12	100%
Upper Salmon Creek (18 3)	9	70%

The removal of this large wood from the riparian areas and the stream channels has resulted in reduced channel complexity, reducing the number of areas with high quality habitat for fish and other aquatic species. Nearly every reach surveyed in the last five years, in each sub-watershed, did not meet minimum objective values for large pools, which are an important habitat for adult fish. It should be noted, however, that the natural conditions of streams in the upper watershed may be below objective levels for LWM due to the high fire frequency, the generally smaller tree size in higher elevation areas, and the relatively faster wood deterioration rates of high elevation tree species. Other potentially limiting habitats affected by levels of large wood include spawning gravels, rearing areas, and overwintering habitat (see the Aquatic Habitat discussion in Chapter IV, Reference and Current Conditions). The greatest area impacted by timber harvest within riparian reserves are located adjacent to Class II and Class IV stream channels.

Stream channels with the greatest amount of adjacent stand replacement timber harvest are associated with the greatest adverse impacts. Short term impacts include the loss of fine organic material input to stream channels. Long term impacts are primarily associated with the loss of existing and potential LWM.

Removal of mid and late-seral forests within and near riparian areas may have resulted in a decrease in lake/river aquatic/riparian and riparian guild species that use mid/late seral habitats, with a corresponding increase in such guilds that use early seral habitats.

QUESTION 7

How have our vegetation management practices affected the Salmon Creek Fish Hatchery and the City of Oakridge emergency and secondary water supplies?

FISH HATCHERY

Summertime water temperatures in Salmon Creek have dropped but are still above desirable levels. The hatchery uses water from a well to moderate water temperatures. Increases in suspended sediment in Salmon Creek have likely increased maintenance costs for the hatchery. The ponds must be cleaned periodically because of sediment deposition. Suspended sediment also has the potential to adversely affect eggs and fry. The increased bed-load movement in Salmon Creek is adversely affecting the diversion dam.

See the answer to question 4 under Issue #1. Salmon Creek has been identified as a secondary municipal water supply for the City of Oakridge during the summer months. Currently the city plans to use this source only during emergency situations such as controlling large fires. No adverse impacts have been identified affecting the suitability of Salmon Creek for this purpose. Suspended sediment and bed-load movement have the potential to affect the quality of municipal water and the intake of the water system.

QUESTION 8

How will we protect small wetlands, seeps, and springs from management activities?

Site specific project analysis should indicate where small wetlands are relatively abundant. Management prescriptions for these areas should recognize that some percentage of these wetlands may be maintained in late-successional seral stages and some percentage in early-successional stages to provide for higher species diversity.

ISSUE #2

The exclusion of natural fire from the ecosystem has altered the natural processes.

ISSUE #2 KEY QUESTIONS

QUESTION 1:

Fire pattern, fire behavior, and burn intensity are affected by fuel loading conditions. How do current conditions compare to fuel loading conditions before the advent of fire suppression? What areas are at high risk?

There has been no significant change in terms of overall average fuel loading (tonnage or total fuel available) from reference conditions over the whole watershed. However the pattern of stands and their respective fuel loadings is very different now: less in the eastern third and more in the western portion where stands are smaller and with more edge.

The risk of stand replacement fire is more a function of stand age: young stands have more flashy fuels and younger trees are more susceptible to damage by fire. Subwatershed 18 1 has a larger number of acres in stands 0 to 80 years of age than typical reference conditions had (it has nearly doubled, from 20% to 40%). If late-successional and old-growth stands are important to maintain diversity and meet management direction, fire suppression efforts become very critical. This means access, fuel breaks and quick response in addition to fuels reduction efforts since fuels reduction would reduce the fuel loading conditions of these seral stages. Protection of younger stands is vital to bring area back to more older seral stages. Roads that once could be used as fuel breaks are rapidly becoming inaccessible by vehicle and non-functional as fuel breaks due to vegetation encroachment.

Identified areas of high risk are high mortality areas of the Warner Creek fire and the 1967 Dead Mountain fire. Older stands could also be at risk due to increased fire severity related to the gradual accumulation of large fuels, the continuity of those fuels, and past fire suppression in those stands.

QUESTION 2:

If we utilize prescribed fire within established forest stands (as opposed to post-harvest site preparation) in order to reduce high fuel loading and bring the landscape back to the reference condition, under what conditions could we control the fire? How many acres (per period of time and land allocation) and under what conditions could we prescribed burn and still remain within air quality limits, and where are the high priority areas?

PRESCRIBED FIRE CONTROL CONDITIONS:

- If the arrival of a weather front could be accurately predicted;
- If management can be flexible in terms of timing (season and year), budget expenditure, in terms of risk of exceeding prescription, as well as accepting potentially negative short term resource effects;
- If fire in riparian reserves is acceptable;
- Stands with lower fuel accumulations (100 to 200 years old) may be underburned with more control;
- Fuel loading is not a special concern, rather when and how the fuel burns. Any age stand can burn catastrophically under extreme conditions but stands that have been underburned may not burn catastrophically under extreme conditions;
- Air quality is not now a limiting factor as long as ignitions occur before July 1st or after September 30th, which is when conditions would be most favorable for control;
- Priority areas for prescribed underburning would be the LSR and adjacent areas to prevent future catastrophic fire in an area where late-successional habitat is currently at low levels.

During the Warner Fire Recovery Project, Charley Martin, District Fuels Management Specialist, addressed the issue of allowing natural fire to burn within a prescription that would reduce fuel loadings and preserve habitat (Final Environmental Impact Statement, Warner Fire Recovery Project, Appendix B). Results are felt to be consistent with our ability to introduce prescribed fire into natural stands to meet the same requirements, given that the probability of ignition will change because we are the ignition source. Higher elevations will become available in early to mid summer even though conditions for burning will be similar to those found in the spring. However, the probability of exceeding prescription will be higher and the probability of a rain event will be somewhat lower in early to mid summer (Table 4).

Table 4: Fire Prescription Probabilities for Any Given Year

Time of Year	Probability Rx* 5 Day Window	Probability of Rain in Rx**	Probability of Exceeding Rx***	Probability of Ignition
Spring	Moderate / High	Moderate	Moderate	Low
Summer	Low / Moderate	Low	High	High
Winter	Unknown	High	Low	Low / Unknown

* Probability includes all windows, all years
** With 1 foot and greater flame length
*** If given a window, what is the likelihood it will exceed prescription

Smoke management and air quality are discussed in the Reference/Current Conditions chapter.

QUESTION 3

Under a reference condition fire regime, what would the habitat diversity look like? Where could prescribed fire help us to re-establish or maintain the reference condition?

Reference era terrestrial wildlife habitat conditions were discussed in Chapter III. Reconstructing reference condition habitat diversity involves varying degrees of speculation in an effort to fill in the gaps where knowledge of fire history is weak, and overcoming limitations such as using a 200 year fire history timeframe. Other limitations include accurately predicting the timing, intensity, and extent of underburns between stand replacement fires.

Within the eastern one-third of the analysis area, fire suppression may have contributed to changes in edge habitat abundance that may have naturally developed along the borders of fires which frequently and extensively affected vegetation in this area (creating the early seral portion of edge habitat). Fire exclusion may have allowed late-seral habitat conditions to develop in areas that might have otherwise been exposed to repeated burns. Relatively more late seral and old-growth habitat is present now than under reference conditions (compare Figures 28 and 29 on pages 48 and 49 of Reference/Current Conditions chapter). This trend toward later seral habitat continues as fire regenerated stands are allowed to mature under a relatively low level of intensive timber harvest or repeated large scale and frequent fires. The result of having large tracts of timber maturing into late seral and old-growth forests is a shift in the biotic community from early and early-to-mid-seral habitat users to mid-to-late and late seral habitat users.

This effect has increased the capability of portions of this watershed in the LSR to contribute to meeting long-term management objectives for LSRs. However, much of this area (and other portions of subwatersheds 18 2 and 18 3) that have matured into late seral and old-growth habitat is not within the Douglas fir/western hemlock plant associations most suited to spotted owls, but is within the true fir/mountain hemlock plant associations best suited to a host of other species (e.g. mountain chickadee, pine grosbeak, heather vole). This trend has also reduced the abundance of early seral habitats which may have reduced capability to support high elevation early seral or contrast species such as boreal owls, elk, Cassin's finch, calliope hummingbird, mountain bluebird, and green-tailed towhee.

It is difficult to assess whether fire exclusion has increased, decreased or had a neutral effect on the abundance of edge habitat above and beyond that created by timber harvest without accurately knowing the intensity and patchiness of historic fire events. Frequent reburns of an area may have a tendency to mask the natural complexity that may have been present within this fire affected area, and speculations on what the potential pattern and intensity of suppressed fires might have been is difficult.

In some areas throughout the watershed where late seral/old-growth stands remain, evidence suggests a shift from a more open forest habitat to a gradient between densely-structured and open-structured habitat. This shift in late seral/old-growth habitat structure would increase suitability for some species (e.g. spotted owl) and decrease suitability for others (e.g. northern goshawk).

An analysis of forested stands less than 80 years old on soil types that are commonly found associated with special habitats (SHABs) identified 980 acres that can be classified as potential SHABs. The age of these stands and their positions on the landscape (often located adjacent to or in the immediate vicinity of existing SHABs) suggests these areas were once SHABs that may have become forested due to fire suppression.

These areas, and portions along the western edge of the High Cascade Plateau where big game forage quality and quantity would benefit from the effects of fire, are candidates for prescribed fire. Prescribed fire could assist in maintenance of reference conditions elsewhere in the watershed such as areas where underburning historically provided open late seral/old-growth forest habitat - particularly in Douglas fir plant associations.

In some areas of the watershed, particularly in Douglas fir/western hemlock plant associations, episodic historic natural fire events were favorable to early-mid seral plant species by recruiting seral species into canopy gaps. This created relatively stable percentages of species numbers. Over the long term, fire suppression and forest succession may pose the biggest threat to herbaceous fire dependent species. While early seral vegetation created by harvest activities may be more diverse in the short term following harvest, subsequent shrub and sapling competition, roadside re-vegetation with non-native species, noxious weed and other non-native spread may result in replacement of species that historically were adapted to periodic low to moderate intensity fire events.

QUESTION 4

How would prescribed fire affect TE&S and ROD species habitat, fire dependent plant species, big game habitat, and aquatic species habitat?

Late seral species, such as the spotted owl, could experience a short term loss of habitat for their prey species but a long term benefit to structural development of late seral stands. Great gray and flamulated owls could benefit short and long term due to the creation of contrast habitat. Falcons could benefit short and long term as fire effects improve prey species habitat and enhance hunting success over a more open canopy. Wolverines may also benefit short and long term as habitat for their most important prey (big game) improves.

Prescribed fire can enhance forage quality in the short term and cover quality in the long term.

Openings created by fire would be favorable for early-mid seral plant species habitat by opening canopy cover, scarifying seeds, and preparing seed beds with reduced competition and high nutrient availability.

Repeated low to moderate intensity fire events help maintain open habitat, and encourage sexual and vegetative reproduction. Historic natural fire events were beneficial to most plant species, assuming fires occurred during the time when plants had completed their reproductive cycles for the year.

Moderate intensity fall burns may assist in germination of fire dependent species such as woodland milkvetch and branching Montia. The Warner Creek and Shady Beach fires both burned in the fall and both fire areas experienced increased germination of these two species. It is unknown whether spring fires would stimulate these species to germinate.

Short term effects to aquatic habitat include increased water temperature, decreased shade, increase in water pH, increased sedimentation rates, increase in nutrient output, abrupt change in aquatic foods with associated change in insect populations, creation of additional large woody material input (existing large woody material usually not affected), and could cause a long term shortage of new large woody material input. Aquatic habitats will recover as vegetation recovers. Increased sunlight, nutrients, and insect populations can be a benefit to fish. Smaller order streams would be more likely to see these effects.

Prescribed fires may be detrimental to localized populations of sensitive and threatened amphibian species such as salamanders and frogs. The existence of supplemental Late-Successional Reserves and Riparian Reserves may help to minimize these effects if these areas are not subject to prescribed fire. Also cool or patchy burns may facilitate escapement of individuals within such populations.

ISSUE #3

The density, condition, use, and location of road and trails has altered the landscape processes and influenced wildlife habitats.

ISSUE #3 KEY QUESTIONS
ROADS (system and non-system)
QUESTION 1:

Where has the density, condition, location, and use of roads influenced natural and management induced disturbance (i.e. landslides, surface erosion, slope movement)?

Road related slope failures have altered the spatial and temporal distribution of landslides within the Salmon Creek watershed. Although landslides occurred during pre-management conditions, roads within the watershed have increased the frequency of these events when compared to the natural condition.

The majority of road related debris slides likely occurred before 1970 and are associated with sidecast construction techniques on steep terrain. Failure mechanisms associated with this construction technique come in two stages; immediate, and delayed with approximately a 20 year gap between the two.

The majority of inventoried road failures have occurred in subwatershed 18 1. As can be seen in Reference/Current Condition Figure 5 (Roads on slopes greater than 40%), the highest number of these inventoried road failures are located south of Salmon Creek in Subwatershed 18 1 (Planning Subdrainages 18Z, 181, 182, and 183). The majority of road construction activity occurred during the 1960's and 1970's and the greatest risk of road failures generally occurs within the first two decades after construction. Therefore if roads are properly maintained, it is likely the rate of road related failures due to unstable fill material will be lower in future decades when compared to rates observed over the last two decades. Another potential source of sediment from roads is the potential for the capacity of culverts to be exceeded during high runoff events. In addition, lack of road maintenance could result in culverts being plugged or otherwise non-functional. Data from the Watershed Improvement Needs inventory indicates a high proportion of undersized stream crossing culverts and road relief culverts with partial to total blockages (see Reference/Current Condition chapter, Table 4). Failure of these structures could result in catastrophic failure and erosion of the road fill and possibly initiation of a debris torrent. These events have the potential to deliver large quantities of sediment to stream channels with associated damage to aquatic and riparian habitat.

QUESTION 2:

Where and to what extent have the presence, patterns, and use of roads and trails affected native and non-native plant and animal habitat diversity, species composition, guild viability, amount of interior habitat, habitat connectivity, and riparian reserves?

TERRESTRIAL WILDLIFE EFFECTS
INTERIOR FOREST, HABITAT, CONNECTIVITY, DIVERSITY, AND FAUNAL SPECIES COMPOSITION
Terrestrial wildlife guilds whose habitat requirements might benefit from the road network established in this watershed could include patch species with small home ranges that select for early seral (e.g. bluebird spp., fence lizard), mosaic species with small home ranges that select for early seral (e.g. mountain quail, black-tailed rabbit), contrast species with small to medium home ranges that select early seral (e.g. dusky flycatcher, big brown bat, little brown myotis), and most generalist species especially those with smaller home ranges that select for early to mid seral habitat. Guild maps in Appendix A can be referenced to see how current guild habitat has changed and to see that changes can often be associated with areas having higher road density.

The effect of the influence of roads on wildlife populations such as deer and elk has been the focus of many studies and has been discussed in numerous publications (Thomas 1982, Mannan et al. 1994). References on this subject can be found in Appendix H of this document.

Concerns about the effects of roads on big-game animals generally are not associated with the road itself. The negative influence of roads on big-game animals is associated with humans that use the roads. The potential effectiveness of otherwise appropriate habitat for big-game animals is thus diminished as open road density and traffic levels increase in areas where these animals are hunted. Open road densities greater than 2 miles per square mile of habitat have potential to significantly reduce elk use in an area. Eight of the eleven Big Game Emphasis Areas in this watershed currently exceed 2 miles per square mile of habitat. The habitat effectiveness variable for roads is currently below Willamette National Forest standards for six of the emphasis areas (Reference/Current Condition chapter, Table 45).

Frequent human disturbance associated with roads and trails is known to frighten big-game animals from distances ranging from .4 miles to .8 miles. The disturbance response by elk has been found to be greater towards slowly moving vehicles on lower level forest roads than towards faster moving vehicles on more improved forest roads. Table 5 shows that overall 82% of the watershed is within .5 mile of a road and 89% is within 1 mile, with a range between subwatersheds of 76%-97% and 77%-99% respectively.

Table 5: Area and Percent of Land Within 1/2 or 1 Mile of Roads

Subwatershed	Total Acres	Total Acres within 1/2 Mile of Road	Percent of Total	Total Acres within 1 Mile of Road	Percent of Total
18 1	35,271	34,160	97	34,767	99
18 2	21,744	14,203	65	16,738	77
18 3	25,417	19,263	76	22,140	87
18 Totals >>	82,432	67,626	82	73,645	89

Table 6: Road Openings and Trails Within Riparian Reserves

Subwatershed	Riparian Reserve Total Acres	Road Type	Acres of Road in Reserves	Percent Reserves in Road Openings	Miles of Trail in Reserves
18 1	11,465	Forest Service	283	2.5	10.4
18 1		SP Railroad	15	0.1	
18 2	6,763	Forest Service	89	1.3	5.0
18 3	7,470	Forest Service	78	1.0	4.6
18 Totals >>	25,698		465	1.8	20.0

Habitat connectivity may have been affected at site specific locations for riparian associated species, but the overall impact of roads on riparian habitat connectivity in this watershed is relatively insignificant. Certain species such as bats may benefit from some road openings in riparian areas. These openings could have value as important feeding sites. Amounts of road openings and miles of trail within riparian reserves are listed for this watershed in Table 6.

Some features associated with roads and trails may provide structural habitat for selected species. These features include roost sites under bridges or in the roof of shelters that could be used by bats, or shelter under boardwalks across wet areas that could be used by amphibians. Some segments of trail are situated close to occupied or potential sites for threatened, endangered, or sensitive plant or animal species. Use of motorized vehicles on trails is restricted in some areas. Seasonal restriction of motorized trail maintenance work has been applied to some segments of trails close to known bald eagle and peregrine falcon nest sites. Based on feedback from the USFWS, relocation or closure of some trail segments to protect T & E nest sites may be appropriate, as well as seasonal restriction of dispersed recreation sites close to occupied bald eagle and peregrine falcon nest sites. The Forest Plan and regional species recovery plans require management plans to be prepared for occupied bald eagle and peregrine falcon nest sites in addition to consultation with the USFWS for any actions potentially affecting these areas. Though spotted owls are present in some areas close to trails and dispersed sites, no activity centers have been identified that are likely to be adversely affected by recreational use of existing facilities.

HABITAT STRUCTURE

Snag and large woody debris habitat generally tend to be deficient near roads. Roads have traditionally facilitated the salvage of down wood contributed from adjacent stands. Many snags are removed from the vicinity of road prisms for safety concerns. As the anticipated level of maintenance decreases and segments of roads are closed or abandoned, certain areas of the watershed may eventually experience an increase in levels of snag and down wood habitat. This restored habitat characteristic may not be long term however, as future access needs into areas would most likely re-open old corridors and result in removal of these components.

NON-NATIVE SPECIES

The extent to which roads and trails may affect non-native species within this watershed is not well understood. Domestic animals such as cats and dogs are known to have been abandoned throughout the

area. When these animals are intentionally abandoned it is usually along a road and often not far from the community of Oakridge. Occasionally pets are separated from their owners along trails or at dispersed campsites associated with roads. The introduction of these animals into the ecosystem is usually short term as they succumb to inefficient survival skills or fall victim to larger native predators. However some relatively insignificant detrimental effects may occur such as competition for habitat and prey resources, or by direct interactions including nest parasitism and predation on native species. Whether or not roads have affected the dispersal establishment of opossum and barred owl populations in this watershed is unknown.

RIPARIAN AND AQUATIC DEPENDENT SPECIES

Figure 1 of this chapter displays the overlap between road clearings (including road surfaced area and altered roadsides) and riparian reserves. Table 6 of this chapter displays the acres of riparian reserves and percentage of overall riparian reserves occupied by road openings. These road surfaces and open areas may pose barriers to movement by the least mobile species, but do not affect the dispersal of more mobile species. Table 3 of the Reference/Current Condition chapter displays the number of stream crossings along roads by stream class. Many of these stream crossings are associated with impassable culverts and/or steep fill slopes and cut banks. These features may also complicate travel for less mobile species. Though railroad tracks are known to pose migration problems for northwestern pond turtles, the length of railway in this watershed is small and most of it positioned where pond turtle migration is not expected to occur.

There are many culverts in the Salmon Creek watershed which create upstream migration barriers for fish. These barriers prevent these fish from utilizing suitable habitat located above these barriers. In some situations, resident populations of trout exist above barriers however they are currently genetically isolated. It is also known that in small tributary streams with high winter water velocities, trout commonly migrate downstream to overwinter in larger, deeper streams (Benhke 1992). When impassable culverts are present these fish migrate downstream, but are not able to migrate back up stream. Along the mainstem of Salmon Creek and Black Creek all stream crossings are bridges and therefore do not affect migration. In fish bearing tributary streams however, stream crossings are generally associated with culverts. Nearly all of these culverts create upstream migration barriers.

PLANTS

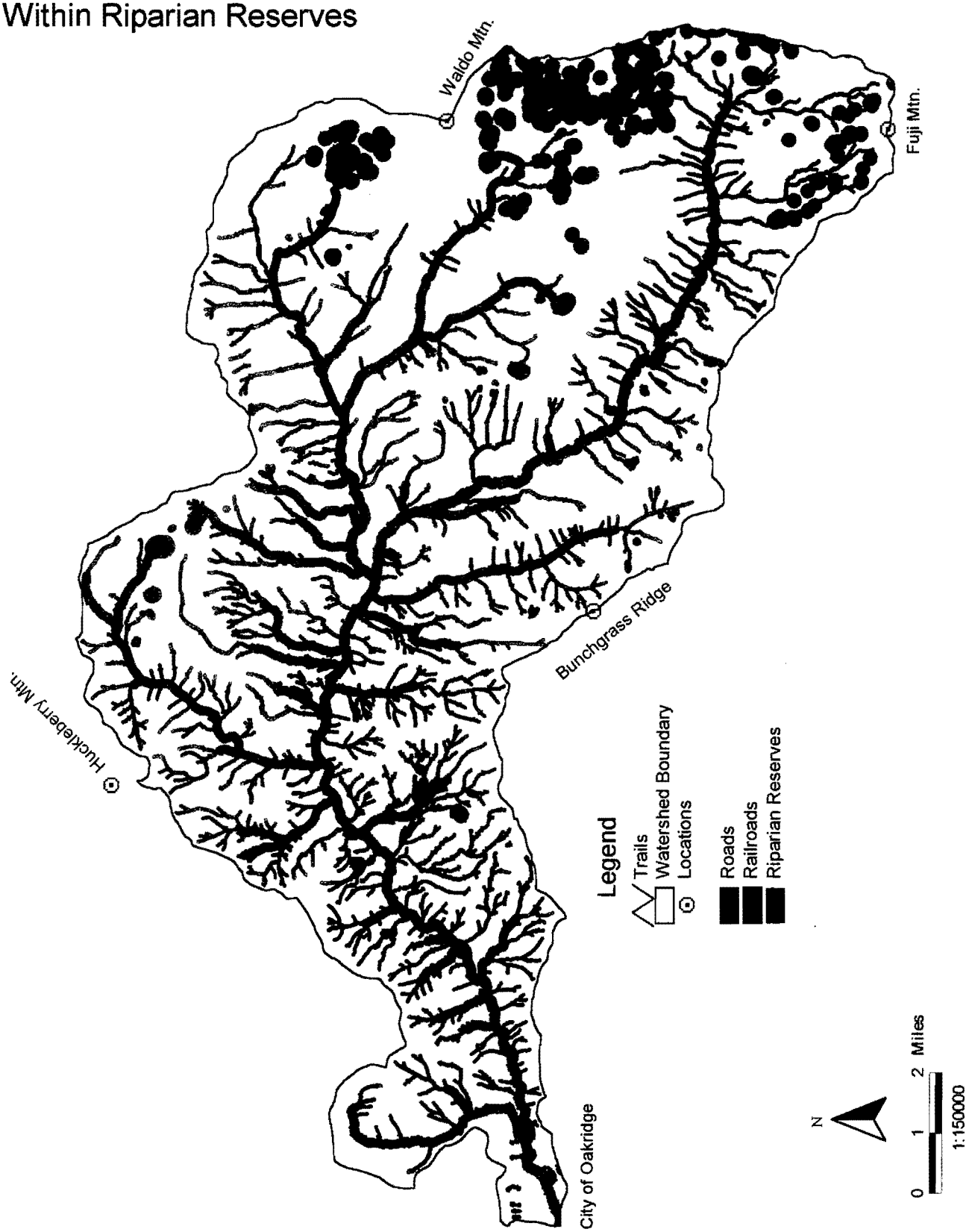
The extent of effects of the presence, patterns, and use of roads and trails on special habitats or threatened, endangered, and sensitive species is not well documented at this time. Many sites have been altered, degraded or created by past management actions. Road cuts have potentially affected natural meadows by intercepting ground water or serving as a noxious weed vector. In other cases, special habitats may have been created or enhanced by impoundments, rip rap placed over tall fill slopes, or construction of bridges. Many instances of the creation of "linear" meadows and wetland habitat is evident in this watershed.

Some sections of trail cross areas that have been or may be altered by the type and level of use. In some areas trails pass across meadows and rocky areas (special habitat areas). In such areas extensive use by horses, motorcycles or mountain bikes may deepen trails which could effect the moisture regime of the meadow, or may loosen rocks that support the trail surface, causing raveling off at the trails edge. These occurrences are site specific as many miles of trails exist that have little or no effect on special habitats.

Several non-native plants are now well established in the vegetative communities in the watershed. Non-native vegetation will continue to be a formidable presence in the landscape. Continuing invasion and establishment will occur, whether from inadvertently traveling on vehicles/equipment, from stock packing use on trails, spread by road grading activities, perpetuated by timber harvest, or road right-of-way maintenance activities. These non-native plants out-compete natives in meadows formerly grazed and seeded with forage mixes, or by non-native erosion control and roadside seeding. Roadsides, temporary spur roads, and firelines often serve as seed beds for noxious weeds. The percentage of acreage in the watershed within a half mile and within one mile of roads indicates that the majority of the watershed is subject to the threat of changes in species composition by weed spread (see Table 5 of this chapter). However, if roads are closed and allowed to overgrow, many noxious weed and non-native populations would eventually become shaded out by overtopping vegetation. The same trend holds true in maturing stands. Some will remain in the system as they are already naturalized species. Of concern are upper elevation areas where tree regeneration is slower and migrating weed populations could invade and establish and displace native plants, and floodplain areas where Himalayan blackberry and other invasive non-natives exist.

Figure 1:
Roads, Railroads, and Trails
Within Riparian Reserves

Salmon Creek Watershed Analysis



Interpretation

Some introduced species have contributed to social and economic well being by offering berry picking opportunities, by enhancing scenic quality, by controlling other undesirable exotic species, providing for erosion control, and providing flowers for sight-seeing. Others have less desirable social and economic effects such as toxicity to livestock, infestation of agricultural areas, contamination of food stuffs and buildings, depredation on crops and poultry, and reduction of bird watching opportunities in some areas. Loss of native species can have social and economic effects in terms of entity and medicinal values.

QUESTION 3:

Where has the density and location of roads affected hydrological function (i.e. wetlands, expansion of the drainage network, and streamflows)?

Roads contribute to increases in peak streamflows primarily due to the area of road surface that has a reduced infiltration capacity, more rapid routing of water to streams in roadside ditches, interception of subsurface flow and conversion to more rapid surface flow, and in some situations the formation of gullies where runoff is concentrated below culvert outlets .

Interception of subsurface flow by a midslope road can result in the area below the road becoming dryer due to a routing of water away from these areas. Roads can create areas of increased surface water by concentrating water in roadside ditches on the upslope of the road, or surface water may be increased in those areas where relief culverts concentrate runoff from roadside ditches below culvert outlets.

Adverse road related affects are most likely to occur where road construction has occurred on mid-slopes. Figure 5 of the Reference/Current Condition chapter displays a map of roads within the watershed on slopes greater than 40 percent. The highest overall road density is found in subwatershed 18 1. Current Road densities by subwatershed and planning subdrainage can be found in Appendix D.

QUESTION 4:

What are the potential resource effects of not maintaining all the roads in this road system due to lack of funding?

Since the timber harvest program has declined with an associated decrease in road maintenance funding, road maintenance will not be done to the extent it was in the past. Road maintenance will be concentrated on the maintenance level 5 and 3 roads. Maintenance levels will have to be reconsidered and lowered on a portion of the road system so as to balance the budget with the maintenance program. This will result in some of the system roads that have been accessible by passenger cars now only being accessible by high clearance vehicles and in some cases not being accessible at all. Brush will encroach into the roadway on some of the system roads, making them impassable. Rock fall, tree fall, and slope ravel will close roads or make them accessible only to high clearance vehicles. Some loss of the roadway is possible from failed drainage systems and embankments. As a result we could see a loss in accessibility to some dispersed recreational sites and opportunities.

If roads are not maintained there is a higher probability of culvert and roadbed failures and formation or extensions of gullies below culvert outlets. These road related problems could introduce sediment into the stream system. Such introduction could silt in spawning gravels, reducing the spawning success of native trout and potential future salmon and bull trout. Introduction of sediment would also increase stream turbidity. Culvert failures could also block up-stream migration of fish.

Decreased maintenance will compromise drainage structures, resulting in diversion of water onto fill slopes, creating an increased likelihood of road related slope failures.

QUESTION 5:

Where are the high risk or high priority road/stream crossings which do not have drainage structures designed to withstand 100 year events?

With the exception of several site specific project areas (Heart and Finberry timber sales), the answer to this question is not known. An adequate amount of time was not available to do the extensive analysis needed to generate this information.

ACCESS

QUESTION 6:

How does changed access influence the potential for human caused fire ignitions, suppression response time, and the amount of acres burned?

The Willamette National Forest Fire Management Analysis System (NFMAS)-
This planning process was developed to provide fire managers with optimal organizations and funds for fire suppression. Included are three segments; Level I analysis, Level II analysis, and Initial Attack Assessment (IAA) model. Level I analysis introduces all of the elements used to build a database for IAA, except for fire behavior information (output from Level II). This includes weather data, fire occurrence, fire management analysis zones (FMAZ), and representative locations (RL). The IAA model uses Level I data and combines it with resource values, suppression costs, escaped fire sizes, and resource information loss/benefit (Net Value Change or NVC) information. IAA also utilizes fire behavior information that is called Level II. The output from the model provides information on the changes in the number of acres burned, resource loss and emergency suppression costs over an array of alternatives (9 alternatives were used). Alternative 4 was chosen because it represented the least Cost + NVC.

Table 7: Wildfire Response: South Zone (non-wilderness)

Location Code	District	Type Response
RL1	Rigdon	Roaded -- Engine
RL2	Lowell	Roaded -- Engine
RL3	Oakridge	Roaded -- Engine
RL4	Rigdon	Roaded -- Hand
RL5	Lowell	Roaded -- Hand
RL6	Oakridge	Roaded -- Hand
RL7	Rigdon	Roaded -- Hand or Air
RL8	Lowell	Roaded -- Hand or Air
RL9	Oakridge	Roaded -- Hand or Air

Table 8: Wildfire Response: South Zone (wilderness)

Location Code	District	Type Response
RL1	Rigdon	Hand
RL2	Oakridge	Hand
RL3	Rigdon	Air
RL4	Oakridge	Air

Representative locations for this analysis were chosen based on primary type of first attack and time of attack on fires that occurred from 1970-1989 by district. Oakridge is assigned RL3, RL6, RL9. The types of first attack for the non-wilderness FMAZ were grouped into 3 categories: roaded (primarily an engine first response), roaded dispersed (primarily a hand first attack), and remote non-wilderness (primarily attacked from the air or by ground forces). The types of first attack for the wilderness FMAZ were grouped into two categories: hand and air. The above information is displayed in Table 7 and 8 on previous page. Time to first attack was assigned as one hour.

It is important to remember that this analysis was based on a period of time when most of the district road system was established and fire size was minimized due to accessibility of engines and hand crews. With road closures or road removal, response times are estimated to increase by one half to one hour. This would also mean a decrease in RL3 and an increase in RL6 and probably little change in RL9 since it applies to areas similar to that which is found east of Waldo Lake to the Crest that is non-wilderness. Net changes expected would be increase in response time, increase in fire size, increased number of initial attack forces, increased mop up time, increased use of retardant, and increased resource damage. Overall, an increased Cost + NVC. This situation is currently being addressed on a regional level because of its expected impacts on regional resources such as smoke jumpers, retardant planes, Type I fire crews, helicopters, and rappel crews. Currently there are no fire dollars available to keep roads accessible.

Roads in areas of relatively low road density are more important for fire suppression activities than any given road segment in areas with a high road density.

QUESTION 7:

How does changed access, including abandoned trails and historic sites, affect public and administrative use of the forest?

Closure of roads will restrict the amount of roads used by hunters, firewood cutters, and recreationists in general. Many hunters do not venture far from roads and firewood collectors are closely tied to roads. Road closures would reduce the amount of land accessible for various activities such as driving for pleasure, hunting, special forest product collection, and firewood cutting.

A decrease in maintenance on roads accessing trail heads would make it more difficult for some to access existing trails. Road closures would have the effect of extending the trail system by effectively creating a new trailhead at the point of road closure. Such a trail system expansion could add to or detract from the trail experience and would certainly increase the amount of trail maintenance that would need to be done.

Transformation of roads to trails could increase horse, mountain bike, and ORV use. Business increases 20% at Sentry Market over the summer season (spring fishing through fall hunting). An increase in trail users could seasonally benefit local businesses, especially if increased recreational opportunities are marketed effectively.

A significant decrease in the amount of open roads could reduce the number of human-caused fires but would also hinder our ability to suppress natural and human-caused fires.

ISSUE #4

Aquatic communities may have been changed from reference conditions due to the introduction of non-native species.

ISSUE #4 KEY QUESTION

QUESTION 1:

What are the effects of introduction of non-native species on native aquatic communities?

Stocking of non-native species and strains of fish and the introduction of fish to naturally fishless lakes has occurred since the early 1900's. ODFW has been largely responsible for fish stocking. Anglers have stocked lakes and streams with their favorite fish species to a lesser extent. The introduction of non-native species of fish has negatively affected naturally occurring aquatic species. The introduction of brook trout to many of the lakes has affected downstream native populations of cutthroat trout and rainbow trout, as well as anadromous species such as bull trout. Brook trout often migrate down-stream from the lakes where they were originally introduced. Brook trout often out compete rainbow trout and cutthroat trout and hybridize with bull trout.

The introduction of fish to previously natural fishless lakes may negatively affect species naturally occurring in the lake. Introduced fish prey on frogs and salamanders (which were previously the top predator), as well as aquatic macroinvertebrates and the larger species of zooplankton, thus changing the community structure of the lake. Bullfrogs have similar effects on native species.

The presence of brook trout in upper Wall Creek and upper Mule Creek would prohibit the future re-introduction of bull trout into these areas. Although many of the high elevation lakes that have been stocked with brook trout have outlets that are tributaries to Salmon Creek, brook trout are not present elsewhere in the watershed.

The relative importance of these native non-fish communities varies, depending upon social values. Social values determine whether fishing for native (rainbow and cutthroat trout) or non-native species (brook trout and kokanee) is more important, or whether amphibians native to lakes are more desirable than fish.

ISSUE #5

The diversion dam for the Willamette Fish Hatchery has the potential to fail, which in turn, could disrupt operations at the fish hatchery.

ISSUE #5 KEY QUESTION

QUESTION 1:

Should the new diversion dam be equipped with a fish passage structure?

Currently the diversion dam for the fish hatchery located at approximately river mile one on the mainstem of Salmon Creek does not provide for the upstream migration of resident fish species. In 1994 the Willamette National Forest's Land and Resource Management Plan (USDA, 1990) was amended by the Northwest Forest Plan (USDA, USDI, 1994a). The Northwest Forest Plan contains Aquatic Conservation Strategy

Objectives which apply to all lands administered by the U.S. Forest Service and U.S. Bureau of Land Management within the range of the northern spotted owl. Objective number two states; "Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian dependent species." To comply with this direction, the reconstruction of the diversion dam for the fish hatchery should be designed and constructed to allow for the upstream migration of resident trout species.

ISSUE #6

There is a concern for protection of water quality for the Oakridge municipal water supplies and the Willamette Fish Hatchery.

ISSUE #6 KEY QUESTIONS

QUESTION 1:

What facilities and management activities could potentially contaminate the Oakridge Municipal wells, the emergency municipal water source (Salmon Creek) and Willamette Fish Hatchery water sources?

Available hydrogeologic information indicates the potential for a direct hydrologic connection between surface water in Salmon Creek and the wellfield supplying the City of Oakridge. The Willamette National Forest has developed several documents detailing the policy and direction guiding the protection from contamination source areas of water such as the wellfield supplying the City of Oakridge and other sources of water on the forest. The following is a list of documents containing current policy and direction and a summary of the content of these documents.

- Willamette National Forest Pollution Prevention Plan:
  Prepared in response to Executive Order 12856 to serve as the guiding document covering facilities to reduce the acquisition and disposal of hazardous materials.

- Hazardous Substance Management Plan, Willamette National Forest:
  Policy and direction concerning hazardous substances, their purchase, use, and storage.

- Willamette National Forest Hazardous Material Spill/Discovery Emergency Action Plan:
  Guidance for the response to spills or discovery of hazardous materials within the boundaries of the Forest.

FACILITIES

Any chemical or petroleum spill occurring at the Flat Creek Forest Service complex or on the railroad right-of-way could potentially enter the aquifer. The underground fuel storage tanks at the fish hatchery have been filled with a sand/concrete mixture and therefore may not pose any threat to the aquifer. Past chemical and/or petroleum spills at the old Bald Knob mill site may have potential to enter the aquifer. Old underground tanks and future industrial use at the mill site may also pose a potential threat.

ACTIVITIES

Fuel and chemical spills along Forest road #24 and by the railroad could potentially pose a threat to the aquifer. A number of other activities could also pose a threat. These include meth lab operations and disposal of waste products, vehicle accidents, residential facilities, and illicit dumping,

Currently, the greatest risk to the wellheads supplying the City of Oakridge is from an accidental spill from the railroad or hazardous materials originating from the old Bald Knob Mill site. Although the potential for an accidental spill of hazardous materials into Salmon Creek from Forest Service operations is possible, due to the low frequency and magnitude of these operations, there is a low risk of contamination of Salmon Creek.

QUESTION 2:

Do administrative and recreational facilities affect water quality?

This analysis did not indicate that administrative or recreational facilities in the watershed pose a threat to the municipal or fish hatchery water supply.