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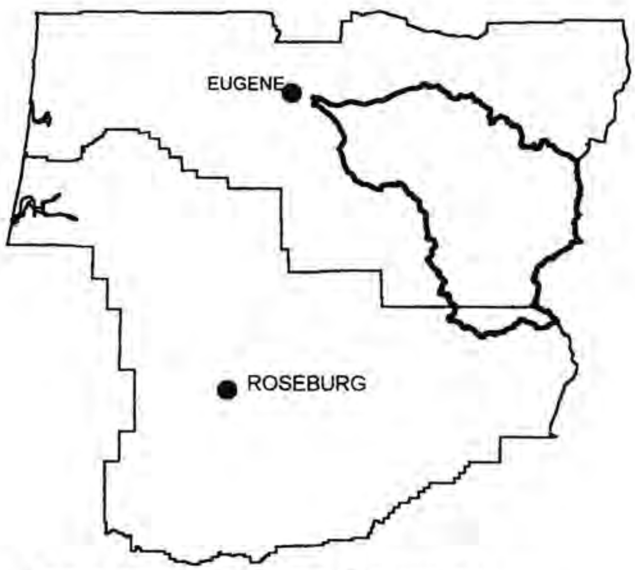
INTRODUCTION

Figure 1:
Vicinity Map

Oregon



Lane and Douglas Counties

Middle Fork Willamette Subbasin

INTRODUCTION

Location

The North Fork of the Middle Fork (NFMF) of the Willamette River contains two fifth field watersheds (Lower NFMF, 17 and Upper NFMF, 24), henceforth referred to as the North Fork, has a total watershed area of over 158,000 acres. It is one of the larger headwater drainage's of the Willamette River that drains the Willamette valley and, through a number of tributaries similar in size to the North Fork, a majority of the west side of the Oregon Cascade mountains. The watershed is located entirely within the Oakridge Ranger District of the Willamette National Forest immediately upstream of the City of Westfir, immediately north and northeast of the City of Oakridge, and begins about 40 air miles east southeast (or about 50 river miles upstream) from the Eugene/Springfield metropolitan area. Approximately 3700 contiguous acres (two percent of the watershed) is privately held, most of which is used for agricultural or forestry purposes, though the watershed also contains the City of Westfir and numerous rural residences.

Management Direction

The North Fork was designated as a Tier 2 Key watershed by the Final Supplemental Environmental Impact Statement (SEIS) on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA, USDI, et. al. 1994b). This Key Watershed designation recognizes the high water quality and potential anadromous fish habitat provided by the North Fork. This SEIS has become popularly known as the Northwest Forest Plan, and has resulted in the amendment of the Willamette National Forest Land and Resource Management Plan (USDA Forest Service, 1990).

The Northwest Forest Plan Record of Decision requires that a watershed analysis be accomplished prior to any land management activity within Key Watersheds. This analysis has been done to comply with his direction and in a larger sense to provide decision-makers with a more comprehensive body of information upon which to base their land management decisions.

Document Format

This analysis tells a story of how this watershed came to have the characteristics it has, of the particularly important processes occurring within it, and how management activities have affected landscape processes and patterns in the watershed. As displayed in the Table of Contents, this story is comprised of the following components:

- A Characterization chapter that described the unique or particularly important characteristics of the watershed.

- An Issues and Key Questions chapter describing the various concerns and opportunities that exist in the management environment and identifying the questions that need to be answered to better make the many decisions that need to be made now and in the future.

- A Reference Conditions / Current Conditions chapter discussing the historical conditions of the watershed and how those conditions have changed over time in order to put into perspective the current condition existing in the watershed; presented in relation to the various relevant resources.

- An Interpretation chapter that explains the differences between historical, current and natural conditions and how those factors affect the watershed's capacity to achieve management objectives, presented in relation to Issues and Key Questions. This chapter provides answers to the Key Questions.

- And a Recommendations chapter that identifies those management activities that could move the system towards reference conditions or management objectives.

This format is based on that presented in "Ecosystem Analysis at the Watershed Scale, Review Draft" (USDA, USDI, 1995). The presentation of this analysis is essentially linear; one page follows another. The processes and features of this watershed are complex, interact with one-another, and can be generally conceived of as a multi-dimensional entity. Telling the story of such a complex phenomenon as a watershed in a linear format invariably will result in a substantial amount of overlap and/or generalization. For example, water quality can be influenced by a number of very different activities, processes, and underlying structures. While water quality can be considered a physical condition (as opposed to biological), biological processes may have profound influences on the quality of water. We beg the readers' indulgence for the unavoidable repetition of some key concepts and conditions as we attempt to illustrate the three-dimensional nature of this watershed and the complex processes occurring within it.

CHARACTERIZATION

CHAPTER I

CHARACTERIZATION

This section describes the dominant physical, biological, and human dimension characteristics of the watershed that are useful in understanding how the processes occurring within the watershed affect its conditions and functions.

Physical

This watershed covers some 158,200 acres which range in elevation from 1000 feet above sea level at the North Fork/Middle Fork confluence to the 7362 foot summit of the Twins on the crest of the Cascade mountains on the eastern edge of the watershed. Approximately one half of the area is above 4000 feet in elevation, though the highest number of acres in any 500 foot elevation range (15 percent of the watershed) is centered on the 5500 foot contour.

The climate in this area is typical of the greater west slope Cascade Mountain ecosystem; a Mediterranean climate with a wet winter, spring, and early summer and usually a quite warm and dry summer and fall. Precipitation ranges from 45 to 80 inches per year, with the highest amounts occurring in the northeastern portion of the watershed (Legard and Meyer, 1973). Above 5000 feet in elevation most of this precipitation falls as snow and accumulations can exceed 10 feet in depth. This large amount of precipitation has, in conjunction with the underlying geology as discussed in the following section, created the diverse topography found in this watershed through stream erosion and glacial action.

The North Fork river is free flowing for its entire length with the exception of a small impoundment, several hundred yards upstream from the City of Westfir, which was once used as the City's water intake diversion. This impoundment does not affect sediment routing or fish passage, though it is a significant hazard to raft and kayak use. An old mill pond dam did restrict fish passage about 2 miles upstream from the confluence of the North Fork and the Middle Fork of the Willamette River. This dam was removed in the summer of 1994 in a joint effort between Lane County and the Oregon Department of Fish and Wildlife as one of the first steps in readying the North Fork for the reintroduction of anadromous fish. Anadromous fish passage into the North Fork is now blocked only by the Dexter and Lookout Point dams near Lowell, Oregon, about 18 river miles downstream from the North Fork/Middle Fork confluence.

GEOLOGIC HISTORY

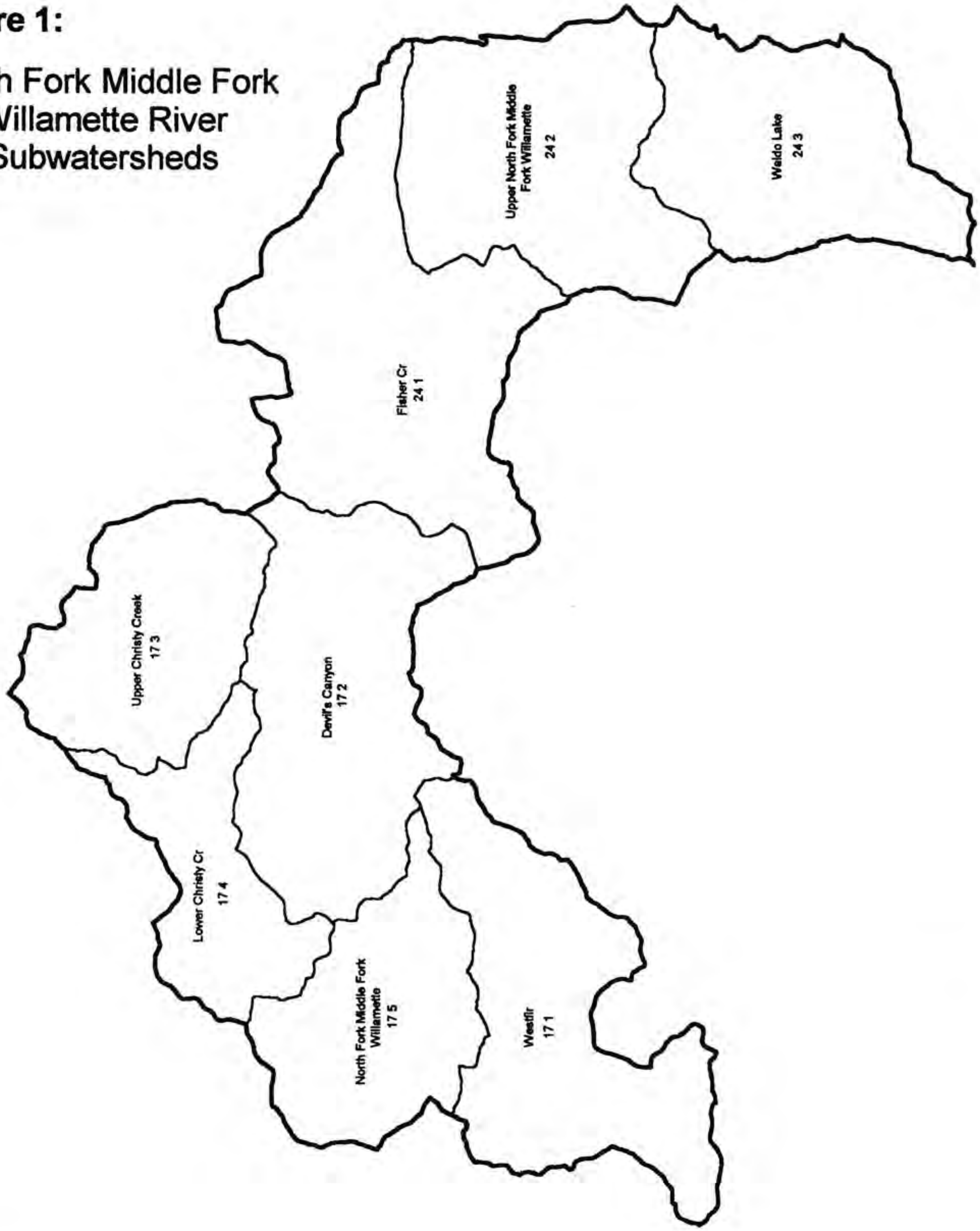
The following is a brief discussion of the geologic features and process that occur within the North Fork drainage and that most directly relate to the current landscape. Additional information regarding the geology of the area is found in the North Fork Wild and Scenic River Plan (USDA, Forest Service, 1992).

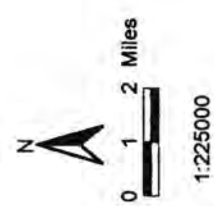
The North Fork basin consists of three distinct geomorphic subdivisions: The Waldo Basin, the Upper Valley and the Lower Valley. These three areas differ in lithologic age, dominant landforming processes and current landscape character.

As described here, the Waldo Basin includes Subwatershed 24-2 exclusive of the northwest corner and all of 24-3 (see Figure 1 of this chapter). This area is characterized by recent glaciation and volcanism, fairly gentle ground, and an abundance of alpine lakes. Soils are derived from recent glacial till overlain by the relatively new mantel of air fall pumice from the eruption of Mt. Mazama (Crater Lake) some 7700 years ago. They tend to be porous and erosive on steeper slopes. Waldo Lake is the dominant feature within the basin and contains some of the purest water in North America.

Figure 1:

North Fork Middle Fork
Willamette River
Subwatersheds





The Upper Valley section runs from the headwaters of the North Fork and Fisher Creek to roughly Devil's Canyon Creek and includes Subwatersheds 24-1, the northwest corner of 24-2 and the east half of 17-2. From a geologic point of view, the area between Devils Canyon Creek and Christy Creek (the west half of 17-2) is transitional between the Upper Valley and the Lower Valley geomorphology. The Upper Valley is characterized by the results of alpine glaciation; i.e. U-shaped valleys, steep channel sidewalls, thin and rocky soils on the sideslopes, and glacial till and alluvium filling the lower sideslopes and valley bottoms.

The Lower Valley includes Subwatersheds 17-1, 17-3, 17-4, 17-5 and the west half of 17-2 and runs from Devil's Canyon Creek to the confluence with the Middle Fork Willamette. This area consists of older, pyroclastic material and extrusive lava flows. Soils formed from this material tend to have a higher clay content, are often quite deep and the landscape is much more dissected than the Waldo Basin or Upper Valley areas. This area contains a suite of soil types that can be unstable, especially that area west of the North Fork in the lower valley. The North Fork is a valley confined channel throughout this portion.

Two unique features are located near the transition from the Upper Valley and the Lower Valley. The first is the occurrence of several large earthflows, most notably within Tumble Creek drainage (currently stable) and Chalk Creek drainage (currently unstable). The second unique feature within this transition zone is the influence of the North Fork Intracanyon Lava Flow. This flat topped, steep sided flow is one of the largest in the region and was deposited within the ancestral North Fork channel. This plain, which is about 5 million years old, can be traced from the vicinity of Lowell Creek to near the City of Westfir. Influences on the landscape include channel confinement of the North Fork, seeps near the basal contact (between First and Huckleberry Creeks), permeable localized hydraulic conduits (Camp-5 Slide), periodic damming and diversion of the North Fork as a result of slope collapse and a large relatively flat area of productive soils.

HYDROLOGIC FEATURES

One of the most prominent features of the North Fork watershed is Waldo Lake with a surface area of 6,298 acres. The surface elevation of Waldo Lake is 5,414 feet and it is one of the largest natural lakes in Oregon. The maximum depth of Waldo Lake is 420 feet. This depth of water is second only to Crater Lake within Oregon. Waldo Lake has a relatively small drainage area with water replenishment by rain, snowmelt run-off, and subsurface flow. There are no permanently flowing inlet streams. However, a number of intermittent streams flow into the lake during the snowmelt season. Due to its relatively small drainage size, it takes approximately 30 years to completely replace the water volume in Waldo Lake (Johnson et al. 1985).

The outlet of Waldo Lake is the headwaters of the North Fork. From Waldo Lake downstream, flow in the North Fork gradually increases due to numerous tributaries and underground sources. The largest tributary is Christy Creek and enters the North Fork at approximately river mile 14.6. The river drops 4,400 feet over its 42.3 mile length. The steepest gradient in the river channel is found in the first 6 miles where the river drops 2,400 feet in elevation. Currently, the only filed water right for the North Fork is for 1.00 cfs for the City of Westfir.

CHANNEL CHARACTERISTICS

The North Fork has considerable variation in its channel features from its source to the confluence with the Middle Fork of the Willamette. Depositional areas, occurring where the gradient is low, typically are less constrained by the valley walls, and have a greater degree of sinuosity (e.g. Cedar bog located in the upper watershed and the reach between Fisher Creek and Camp Five). The lower and upper reaches are narrowly constrained by the valley walls, have a high gradient with low sinuosity, and are largely influenced by geologic features (e.g. "The Gorge" located in the lower watershed). Channel complexity has been reduced from historic levels due to a combination of management activities (primarily riparian harvest and salvage of in stream logs) and natural events (primarily large flood events).

AQUATIC HABITAT

Stream survey reports indicate that prior to 1930 the North Fork had some of the best habitat for anadromous fish within the Middle Fork of the Willamette basin. Habitat complexity in streams and localized stream bank stability has been reduced below natural levels due to removal of in-channel large woody material. In the upper portion of the North Fork and in many tributaries, waterfalls create upstream migration barriers for fish. In addition to these natural barriers, numerous road/stream crossing culverts were installed in a manner that creates additional barriers to the upstream migration of fish and has resulted in isolated resident populations of fish in some streams.

Significant diversity exists in the numerous lakes and ponds that are for the most part located in or adjacent to wilderness areas. The majority of the lakes within the watershed can be categorized as having a trophic status of oligotrophic or ultraoligotrophic. These classifications mean the lakes have low to very low concentrations of nutrients in the water and low organic production.

POTENTIAL CHANGES IN PEAK STREAM FLOWS

Some drainage's that are tributary to the North Fork River have a high proportion of their area located in what is defined as the transient snow zone (especially the lower North Fork, watershed 17). The vegetative condition within portions of the transient snow zone have been substantially altered by stand replacement timber harvest. This condition combined with an extensive road network may have caused higher peak stream flows and associated adverse effects on water quality and stream channel conditions in some drainage's.

WATER QUALITY

The Oregon Department of Environmental Quality (DEQ) has identified beneficial uses for Willamette River tributaries (OAR 340-41-442). Relevant beneficial uses include; public domestic water supply, resident fish and aquatic life, fishing, boating, water contact recreation and aesthetic quality. The Oregon DEQ also has indicated that the North Fork has a moderate (with data) problem rating for water quality conditions, water quality conditions affecting fish, and stream quality conditions affecting aquatic habitat. These problems are primarily due to elevated stream temperatures and the presence of suspended sediment during high flows. The North Fork has no water quality problems associated with water contact recreation or drinking water supplies (ODEQ, 1988).

Tier Two Key Watersheds, such as the North Fork, were identified in the Northwest Forest Plan as important sources of high quality water. The North Fork Wild and Scenic River Plan (USDA Forest Service 1992) identifies water quality as an outstandingly remarkable value. Direction specific to Wild and Scenic Rivers found in 40 CFR 131.12(3) states "where high quality waters constitute an Outstanding National resource, such as waters of National and State Parks, and wildlife refuges and waters of exceptional recreation or ecological significance, that water quality shall be maintained and protected." The antidegradation policy component of the water quality standards requires that the Agency consider water quality impacts in management and activity planning and that no degradation of Wild and Scenic River water quality may occur which will interfere or be injurious to the beneficial uses of the water. Water quality in terms of temperature and turbidity occasionally exceed existing guidelines as further discussed in the Reference/Current Conditions chapter.

SOURCES OF POLLUTION

The primary sources of water pollution along the length of the North Fork River are considered nonpoint sources. These pollutants originate from diffuse sources rather than a discharge at a single location. The primary nonpoint source problems of concern include elevated levels of sediment and increased stream temperatures. Elevated levels of sediment are often associated with soil erosion from road surfaces and hill slopes where vegetation has been disturbed. Elevated stream temperatures can often be attributed to reduced amounts of streamside vegetation, generally from past harvesting prior to establishment of policies requiring retention of riparian vegetation.

WALDO LAKE

High water quality has been recognized as one of the most outstanding attributes of Waldo Lake. The level of purity of the lake water has been compared to that of distilled water. Waldo Lake is regarded by some experts as one of the purest lakes in the world. Due to the low concentrations of nutrients found in ultraoligatrophic lakes such as Waldo, they are considered highly sensitive to adverse effects from nutrient inputs as a relatively small amounts may represent a large percentage increase. The Oregon DEQ has found that Waldo Lake should be designated as an Outstanding Resource Water (ODEQ,1994b). The only other body of water recommended for this designation is Crater Lake.

LAND MANAGEMENT

As further discussed in the following Management History section, this watershed has produced a substantial amount of timber volume over the past seven decades. To date approximately 50,000 acres (32 percent of the watershed) have been regeneration harvested and about 2400 acres have been commercially thinned. This amount of harvest has required the construction of approximately 570 miles of road. Some 57 miles of this road system are paved (including the roads in four of the five developed campgrounds), most of the rest are single lane gravel with turnouts. Most of the system roads in this watershed are crowned with ditches and cross-drain culverts to disperse precipitation falling on the road surface or subsurface flow intercepted by the road cut.

Biological

VEGETATION

Plant communities in the watershed are very diverse and reflect landscape influences, varied soils and landforms, and the wide elevational gradient. Most of the plant associations described by Hemstrom et al. (1987) are represented within this watershed. The North Fork of the Middle Fork of the Willamette Wild and Scenic River Corridor Environmental Analysis and River Management Plan (USDA, 1992) describes the extensive environmental gradient and vegetational diversity found in the corridor as an outstandingly remarkable value.

Approximately 90 percent of the watershed is occupied by coniferous forests ranging in age from several to over 600 years. Other plant community types that are found within the watershed include: herbaceous wetlands (bogs, marshes, meadows dominated by sedges, rushes, grasses); hardwood and shrubby wetlands (hardwood marshes and swamps), coniferous wetlands (cottonwood and western red cedar swamps), red alder forested acres (wet and dry types), coniferous-hardwood forests, temperate and high temperate coniferous forests (with lodgepole pine), subalpine forest parks, rock outcrops, talus and talus/shrub communities, Oregon white oak woodland inclusions, and grass and forb dry hillsides. None of these communities are unique to the province except as mentioned in the following remnant population's section.

The harvesting which has occurred over the last seven decades has created most of the younger age classes but wildfire has had the largest influence of any natural process upon the structure and distribution of vegetation age classes within this watershed.

This harvest period mentioned above was not spread evenly over the watershed. The first 16,000 acres harvested was more or less contiguous. Harvest after the 1940's was more or less evenly dispersed across the lower two thirds of the area. Very little harvest has occurred in the upper one third of the watershed; those areas now occupied by the Waldo Wilderness, the Waldo Lake Recreation Area, and the Chucksney Mountain Roadless Recreation Area. If the amount of past harvest is applied only to the areas outside of the three above unharvested areas, about 50 percent of the land available for timber harvest has already been harvested.

REMNANT POPULATIONS

Though the non-forested areas represent a small portion of this watershed, these areas provide habitat for some relatively uncommon plant communities. One shrub dominated wetland, along the river near the center of the watershed, contains a population of quaking aspen. Aspen is a species not often found on the west slope of the Cascades. Some south-facing rock outcrops also support populations of rabbit brush, another shrub that typically grows only on the east side of the Cascades. Some of the rocky meadow on south facing slopes also contain stands of Oregon white oak. White oak is typically found at lower elevations and is quite abundant in the Willamette valley.

Alaska yellow cedar and sub-alpine fir, trees more typically found at much higher latitudes, can occasionally be found on high ridges and north-facing cirque basins. Whitebark pine, typically a sub-alpine and alpine tree, also occurs in limited areas within the watershed, generally on the two percent above 6500 feet in elevation.

FIRE HISTORY

Aside from the general climate that provides for the forest growth in this watershed, wildfire is the most dominant force shaping the structure and age class distribution of the forest. Over the past two centuries, about 62,000 acres have been subject to stand replacing (or catastrophic) wildfire. Some of these areas have even burned twice in this period. As shown by Figure 2 of this chapter, the wildfire occurrence has not been uniform over the watershed. About 58 percent of the upper North Fork (watershed 24) has experienced catastrophic fire in the last 200 years. About 27 percent of the lower North Fork (watershed 17) has burned during the same period. Average tree ages in undisturbed areas of the lower North Fork indicate that this area probably experiences very large fires that may effect most of the watershed at intervals in excess of 400 years. Approximately 13 percent of the acreage affected by fire over the last 200 years retain small to moderate numbers of trees which survived the last fires.

Stand replacement fire has occurred in almost every decade in the last 200 years. In terms of large acreages burned, the fire return interval (time between large fires) for this watershed is approximately 60 years over the last 200.

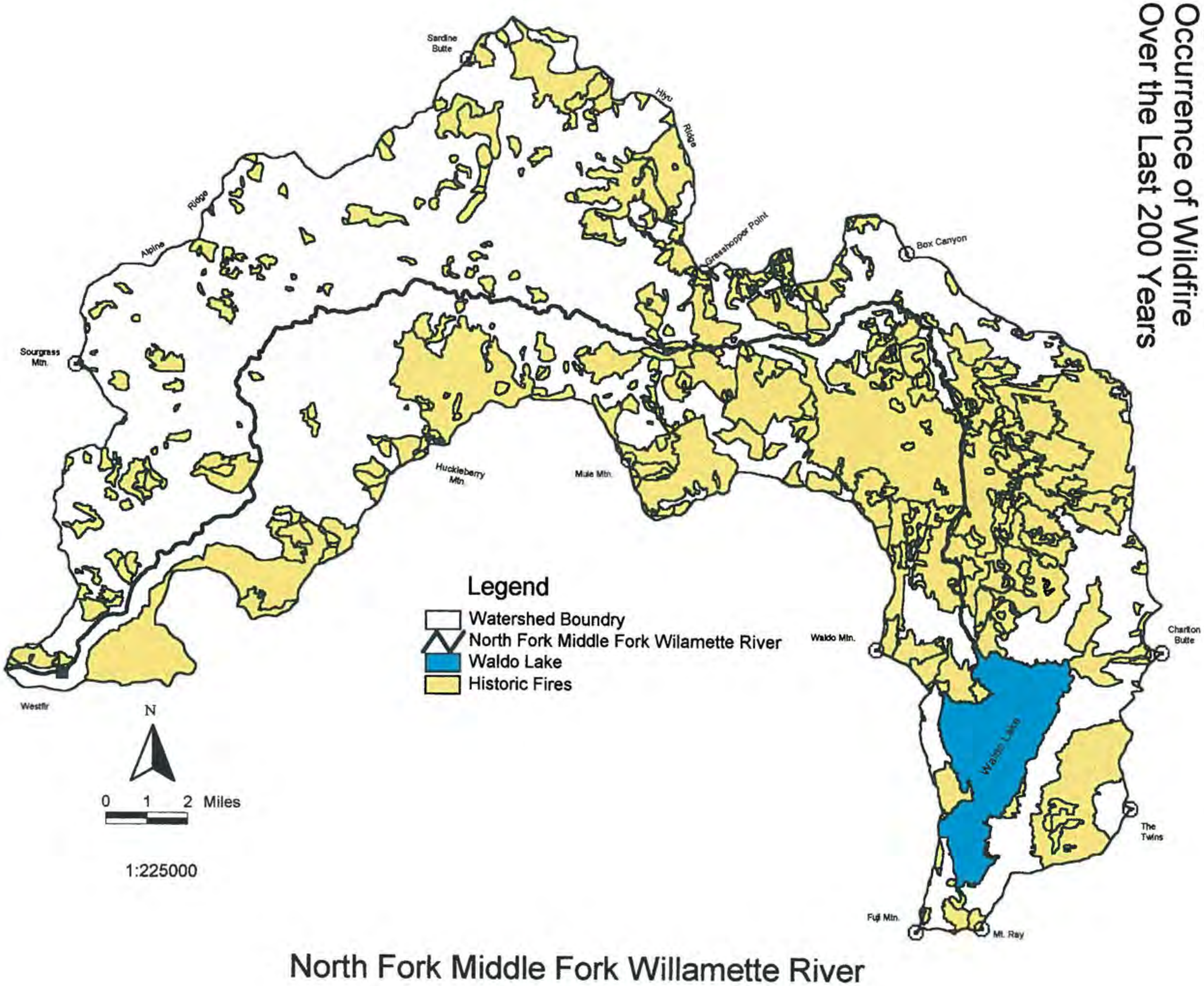
An undetermined number of acres that underburned with low amounts of overstory tree mortality are not included in these wildfire acreage's. Several areas in the watershed have indications of reburning and its profound effects on the structure of the subsequent stands. The large fire that burned around 1900 in the Fisher Creek drainage and around the Erma Bell Lakes north of Waldo Lake, and the fire that burned around 1845 in the Devils Canyon Creek drainage, are examples of such areas. It appears that these areas of underburning were extensive and possibly more frequent than stand replacing fire.

WILDLIFE HABITAT AND SPECIES

GENERAL TERRESTRIAL

The range of elevation, aspect, slope and soil types described previously contribute to the wide range of diversity of wildlife habitat types within this watershed. As described in the Vegetation section, timber

Figure : 2
Occurrence of Wildfire
Over the Last 200 Years



harvest and wildfire have contributed greatly to the diversity of stand conditions and stand ages present within the watershed.

Appendix A contains a list of species expected to occur within the watershed along with their guild identification. Many of the vertebrate species expected to occur on the Willamette National Forest (327 species of birds, mammals, reptiles and amphibians combined; USDA 1995b) are expected to occur within this watershed. The distribution of these species and their aggregation into communities vary with the distribution of plant communities, vegetational condition and climatic conditions across the landscape.

FISH

The North Fork Watershed contains a variety of aquatic species. Wild populations of cutthroat and rainbow trout exist throughout the watershed. Brook trout are present in the extreme upper portion of the North Fork and may also be present in tributaries that flow from many lakes in the upper reaches of the watershed that have been stocked with brook trout.

The North Fork historically supported runs of spring Chinook salmon and steelehead trout. The construction of the Westfir mill pond dam in the 1920's blocked upstream anadromous fish migration. A fish ladder was included in its construction but it was ineffective. Migration was further blocked in the 1950's with the construction of Lookout and Dexter dams. Bull trout are believed to have inhabited the watershed but they are no longer thought to be present due to the introduction of predatory brook trout, lack of an anadromous fish prey base, and dam construction.

There is potential for the reintroduction of spring Chinook and steelehead into this watershed if a method can be developed to capture and transport migrating juveniles downstream where they could be released below the remaining dams. Due to the presence of brook trout (brook trout are known to hybridize and compete with bull trout) in the upper North Fork, there are not currently any plans to reintroduce bull trout to the watershed.

The North Fork watershed contains hundreds of lakes, located primarily in wilderness areas. Many lakes have been stocked with brook trout, rainbow trout, and cutthrout trout. Many of these same lakes originally contained no fish. Little is known about the limnological and biological parameters of lakes within the watershed, with the exception of Waldo Lake.

The introduction of fish to naturally fishless lakes has affected amphibian, macroinvertebrate, and zooplanktom populations (Liss, 1991). These effects may be due to competition for food or due to the fact that these organisms are often prey for introduced fish species.

AMPHIBIANS

There are several sensitive amphibian species located in the North Fork watershed, including the tailed frog, the red-legged frog, and the Cascade frog.

MACROINVERTEBRATES

There is not much information available on the macroinvertebrate species occurring in this watershed. However, several sensitive species of aquatic insects are known to occur on the Willamette National Forest.

Social

There is close relationship between the resources contained in this watershed and use of those resources for employment and recreational opportunities. The area of private land within the watershed includes the Oakridge public golf course and a community cemetery. The North Fork also is the source of municipal water for the City of Westfir, which has a population of 304.

MANAGEMENT HISTORY

NATIVE AMERICANS

The North Fork watershed has experienced use by humans for perhaps 10,000 years. Historic, archaeological and paleoclimatic research in the watershed suggests that people adapted to changing conditions and influenced the development of their environment.

At the time of European exploration at least three tribes are thought to have used the North Fork watershed. The Molala are believed to have had winter villages in the Oakridge/High Prairie area and, with the Kalapuya of the Willamette Valley, to have seasonally visited the higher elevations of the North Fork. In later times, possibly after the arrival of the horse, the Klamath made trips into the area on their way to the Willamette Valley to trade.

Over 50 archaeological sites representing seasonal base camps and more temporary campsites have been found in the North Fork watershed. The majority of these sites are located in lower elevation terraces associated with meadows and prairies which were much more extensive before Euro-American settlement. There is good evidence from Government Land Office survey plats, explorer's journals, tribal oral history, and stand ages adjacent to known prehistoric sites that fire was used as a tool to maintain a more open landscape. Both prairie fires and forest underburning were techniques used to hunt game and to ensure the return of various important plants.

THE HOMESTEAD ERA

The majority of early settlement in the Oakridge area was along the main stem of the Middle Fork Willamette river. Only one homestead was claimed on the North Fork in the 1890's, although nearby settlers grazed cattle and sheep in the area. Stewart P. Brock staked his claim in an open prairie area now known as Brock Meadow. Beginning in 1914, the Forest Service permitted grazing allotments in the North Fork watershed for cattle and sheep. Animals were trailed up the North Fork to allotments at Blair Lake, Major Prairie, Grasshopper and Chucksney Mountains, as well as up into the Taylor Burn area.

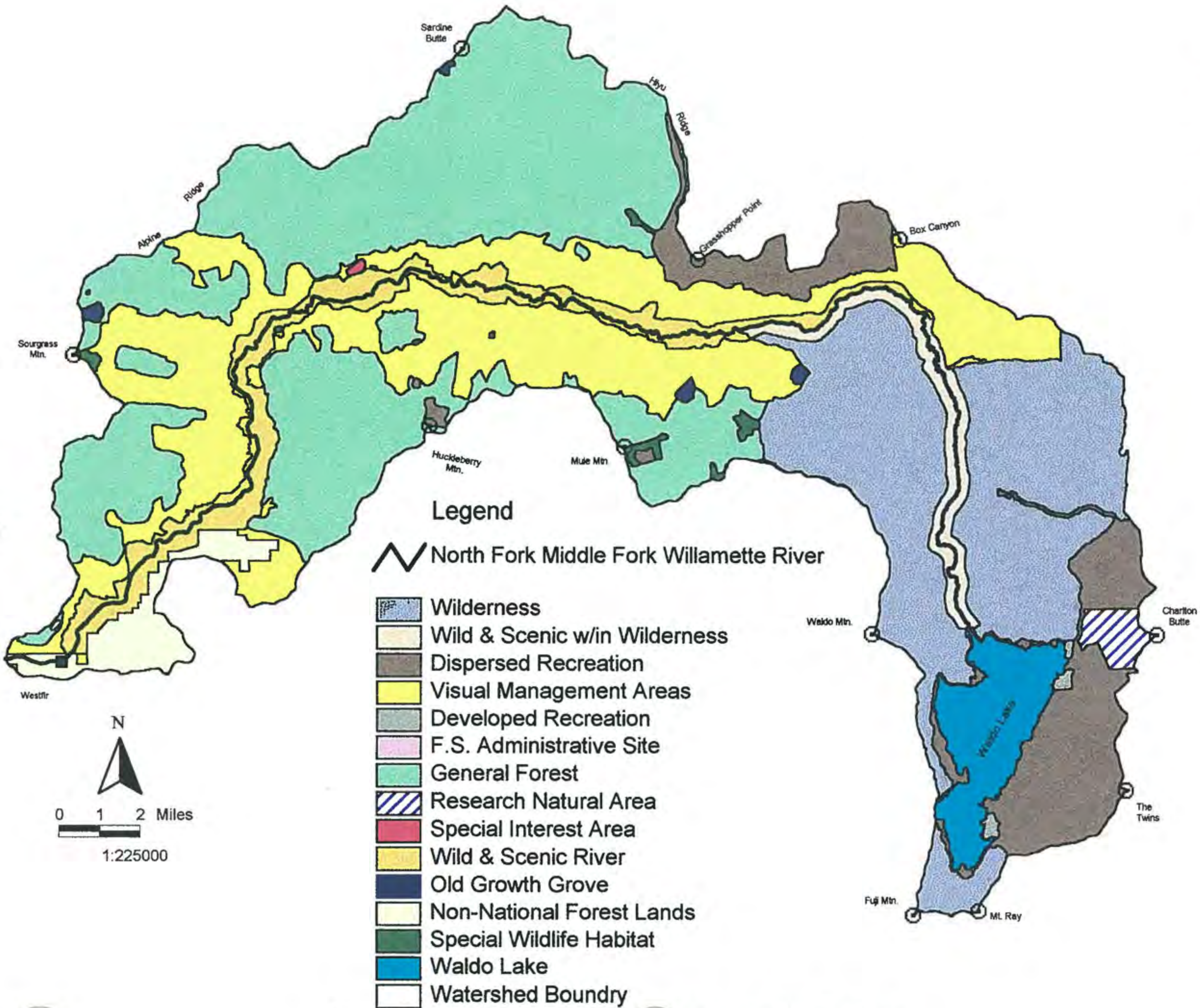
MINING

Gold was discovered in the Christy Creek area in 1881 and was actively mined in 1903. Known as the "Fall Creek Mining District," six claims were developed to some extent with trenches, pits, adits or tunnels. Active mining does not currently occur in the watershed, though several valid mining claims still exist.

FOREST MANAGEMENT

Logging within this watershed began in 1921-22. A dam was built across the North Fork in 1923 and the Westfir sawmill was built. No splash dam construction (often done to transport logs by water) is known to have taken place within the watershed. In January of 1923, the Forest Service proposed a timber sale to include 13,300 acres of the North Fork watershed, the largest sale of its kind to be sold in the Douglas-fir region. This sale resulted in the construction of a mill, town (Westfir), and logging railroad by 1925.

An average of 700 acres per year was harvested between 1925 and 1990. Most of this harvest has occurred in the lower North Fork. After about 1940, log hauling was done by truck, and an extensive road system was built to accommodate the harvest activities.



North Fork Middle Fo[illegible] Willamette River

Figure: 3
1990 Willamette National Forest Land and Resource Management Plan Allocations

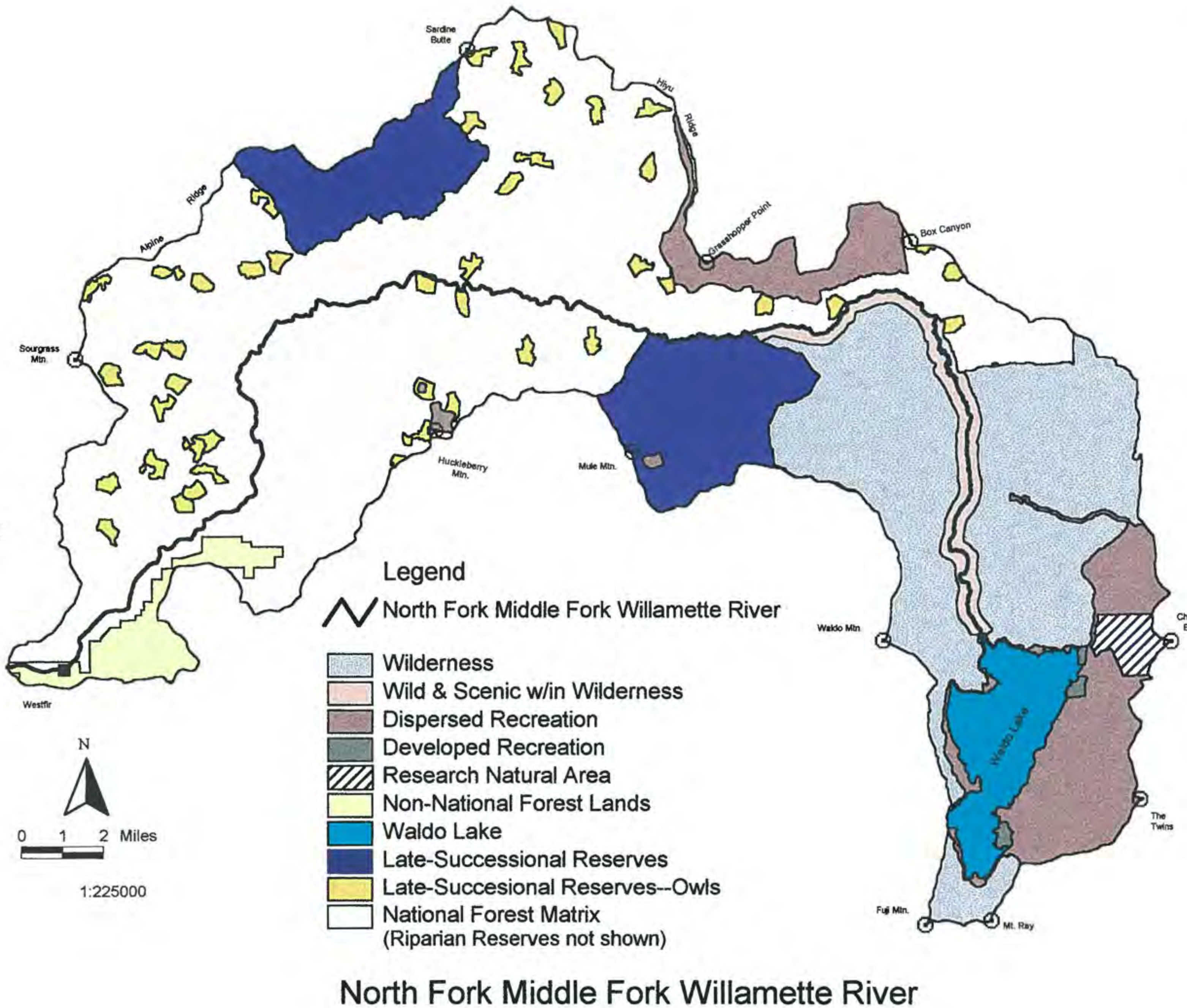


Figure: 4
Ownership Pattern and Forest Plan Allocations as Ammended

In 1979 the sawmill at Westfir burned. A plywood plant continued to operate through 1983 until it too burned. The Westfir mill site was abandoned at that point except for a few small sawmill operations that leased the site for short periods.

In the North Fork watershed, lookout sites or stations were established on Buckhead Mountain, Dead Mountain, Grasshopper Mountain, Huckleberry Mountain, Mule Mountain, Sardine Butte, and Waldo Mountain. The only remaining lookouts still being used for fire detection are the Huckleberry Mountain and Waldo Mountain structures.

A system of trails was constructed. Much of this system was constructed by the Civilian Conservation Corps from 1929 to 1942. The Civilian Conservation Core constructed campgrounds at Kiahanie, Skookum Creek, North Waldo Lake and Taylor Burn. They also built Forest road #1957 from Box Canyon to Skookum Creek.

The Box Canyon road, which crosses the river corridor near Brock Meadows, was built by the Forest Service in the early 1920's as an administrative access road. Some newer roads have replaced portions of the Box Canyon road but many sections remain in their original condition.

MANAGEMENT DIRECTION

The Willamette National Forest Land and Resource Management Plan (USDA, 1990) prescribes land uses by assigning various Management Area designations to land within the Forest. The North Fork watershed contains some 20 such management areas as shown in Table 1 below. (see also Figures 3 and 4 of this chapter).

Table 1: Willamette National Forest Land and Resource Management Plan Management Areas

Management Area	Description	Acres	Percentage
1	Wilderness	35,527	23
4	Research Natural Area	1,178	1
5	Special Interest Area	67	<1
6	Wild and Scenic River corridor	9,186	6
7	Old-Growth Grove	368	<1
9	Special Wildlife Habitat Area	632	<1
10c	Semi-Primitive Dispersed Recreation (Waldo Lake Road and Campgrounds)	2,970	2
10e	Semi-primitive Dispersed Recreation (Waldo Lake and Chucksney Mountain Roadless Recreation Areas)	12,250	8
11a	Scenic, Modification	1,740	1
11c	Scenic, Partial Retention	23,580	15
11d	Scenic, Partial Retention	1,928	1
11f	Scenic, Retention	133	<1
12a	Developed Recreation - campgrounds	179	<1
13	Administrative Use Area	21	<1
14	General Forest	38,065	25
WA	Waldo Lake	6,076	4
Riparian Reserves (1)			about 35
Late Successional Reserve		16,270	10
Supplemental Late Successional Reserves		5,114	3
		58,280	

(1): riparian reserves are included within the acreage of other management areas
* The above acreage's do not include the 3700 acres of private land within the watershed.

The following documents also provide specific management direction for portions of this watershed:

- Environmental Assessment and River Management Plan -- North Fork of the Middle Fork of the Willamette Wild and Scenic River
- Environmental Assessment -- Aufderheide Drive Transportation System and Management Project
- Late Successional Reserve RO220 Assessment

RECREATION

Wild and Scenic River

The North Fork was Congressionally designated a Wild, Scenic, and Recreational River for the outstandingly remarkable values of: water quality, scenic, recreation, geologic, hydrologic, vegetation, ecologic, prehistoric, historic, traditional use-cultural, fish, and wildlife. The Wild section of the river occurs entirely within the Wilderness, the Scenic section occurs where the river is adjacent to the wilderness boundary, and the recreational segment begins where the river leaves the adjacent wilderness boundary at Fisher Creek. See the North Fork Wild and Scenic River Management Plan (USDA 1992) for more information on the conditions, values, and management of this river corridor.

Scenic Resources

Aufderheide Scenic Byway (Forest Road 19) parallels the lower 30 miles of the river. The Byway is the center of a viewshed (designed for scenic, partial retention, MA 11c) in which timber harvest is scheduled so long as harvested areas remain visually subordinate to the characteristic landscape. The Byway is a double lane paved road that continues into the South Fork of the McKenzie River and the Blue River Ranger District, eventually connecting to State Highway 126.

Miscellaneous Attractions

The watershed contains one Special Interest Area (as designated by the Forest Plan) known as "Hell Hole". This area is a deep crack in the steep cliffs on the edge of Christy Flats. The watershed also contains several Forest Plan Old-Growth Groves (the Elk Camp Old-Growth Grove and the harder to access Cayuse Creek and Fisher Creek groves), the Constitution Grove (a stand of 225 year old trees along Aufderheide Drive), the Chucksney Mountain Roadless Recreation Area, the Charlton Butte Research Natural Area, and a number of Special Wildlife Habitat Areas generally centered on meadows or wetlands.

Waldo Lake

The area surrounding Waldo Lake that is not designated as wilderness is known as the Waldo Lake Recreation Area, and is allocated by the Forest Plan to semi-primitive, non-motorized dispersed recreation (MA 10c and 10e) except for the campgrounds and the road accessing them. The Waldo Lake basin offers a set of fairly unique recreation opportunities including boating in extremely pure and transparent water, expansive views over uncut forest lands, hiking, developed and dispersed camping, mountain biking, hunting, fishing, snowmobiling, cross-country skiing, etc. The area is sometimes heavily used on summer weekend holidays but the mosquitoes often keep many people away until after mid-August.

Boating

The lower nine miles of the North Fork attracts mainly kayak (and some raft) use. This portion of the river is considered by some to be one of the best white water runs within the Willamette River drainage (Willamette Kayak and Canoe Club, 1986) though some find the river too difficult to consider it "the best". The section above Camp Five is not as technical and is occasionally kayaked during high water levels. Its proximity to Eugene, and low use makes it attractive.

Waldo Lake's size attracts water craft from motor boats and sailboats to canoes. A debate as to whether motors should be allowed on the Lake, based at least partially on a perception that the use of internal combustion motors could be or is affecting the water quality, has been ongoing for the last ten years. This issue was one of the most mentioned issue in the public response to the 1989 draft Forest Plan. Boats are used to reach Rhododendron Island Campground and numerous dispersed campsites on the Lake's shoreline.

Swimming

In the summer, when the river warms up and the flow slows down, the pools of the lower North Fork are used extensively by swimmers. The beaches adjacent to the Waldo Lake campgrounds are also used in the late summer when the water is warmer and the mosquitoes fewer.

Dispersed Camping

Many dispersed camp sites exist along the North Fork and are well used in the summer because they offer seclusion, easy road access, and proximity to the river. Dispersed sites also exist on the shores of Waldo Lake. These sites are typically accessed by water.

The Three Sisters and Waldo Lake Wilderness areas provide numberless primitive campsites scattered among serene mountain lakes and meadows. The solitude, scenery and fresh mountain air enhance the primitive experience.

There are also a large number of lightly used dispersed camp sites scattered across the watershed. Many of these sites are on old logging landings. These sites are most often used during hunting season.

Fishing

The North Fork is locally known for its fly fishing opportunities. The river has been managed for the last 15 years as a quality fishing river by the Oregon Department of Fish and Wildlife. It is managed as a wild trout river; hatchery reared fish are not put into the river. Fishing is restricted to the use of fly rods and lines above the railroad trestle in Westfir. Recently the river has been opened to year-around fishing as long as fish are released unharmed between the end of October and mid-April. Most of the larger tributaries are occasionally fished, but generally the fish are not large enough to attract very many anglers.

In the past, ODFW stocked Waldo Lake with kokanee, eastern brook and rainbow trout. Stocking was discontinued in 1991 but fish populations are thought to be naturally reproducing. Due to a limited amount of primary productivity the Lake does not support a large fishery but the Lake does contain large fish that can be caught if one knows when and where to try.

Most of the larger wilderness lakes are still stocked with fish. The Erma Bell lakes are the most popular.

Wilderness

The watershed contains 9800 acres of the southwestern corner of the Three Sisters Wilderness Area and about 25,700 acres of the 36,000 acre Waldo Wilderness Area. These two Wilderness Areas are contiguous for the most part (in places they are divided by the non-wilderness Taylor Burn Road corridor) and are located in the upper reaches of the watershed.

Trails

The watershed contains some 160 miles of maintained trails. Most outside the wilderness are open to foot, horse and mountain bike use. About 21 miles of this trail system are open to motorbike use.

Developed Recreation

Five developed campgrounds exist in the watershed; North Waldo, Islet, and Shadow Bay campground are located on the eastern shore of Waldo Lake; Skookum campground is at the end of Forest road 1958 at the northern end of the Waldo Wilderness area; Kiahanie campground is located along the North Fork about 24 miles upstream from Westfir. Except for Skookum Creek campground, all are accessed by paved roads. Fees are charged for the use of these campgrounds. Primitive campgrounds with no use fees exist at Taylor Burn, Rhododendron Island, and Harralson Horse Camp.

Community-Based Recreation and Related Economic Benefits

Because the road leading to the North Fork and Aufderheide Drive leaves Highway 58 before reaching Oakridge, there is no direct contact between recreationists coming from Eugene/Springfield and local businesses. Local businesses are all located in the City of Oakridge about 4 miles past the turnoff to Aufderheide Drive. People approaching the North Fork from the East do pass through Oakridge.

Local residents have long enjoyed employment with companies and corporations extracting timber from Forest lands. Many recreate there as well, hunting, driving for pleasure, fishing, swimming, camping, sight seeing, and berry picking. Many local residents also rely on the area for firewood collection. When the last facilities at the Westfir Mill closed in 1983, and the Pope and Talbot mill in Oakridge closed in 1989, many residents, unable to locate well paying or steady jobs, left the area.

When the amount of land harvested per year diminished recently, people in the local West Fir/ Oakridge area were affected. Recreation activities and events outside the watershed (Willamette Pass skiing, Cycle Oregon, Fat Tire Festival) add a boost to the local economy. Although Aufderheide Drive and the associated North Fork Trail are becoming more popular, its full potential as an income-generating recreational facility for the Oakridge/Westfir area has yet to be realized.

Commodity Production

A substantial amount of timber has been harvested from this watershed over the years; 40 to 50 million board feet of lumber and plywood products, have been harvested annually since logging began in this area, for a grand total of about 3.1 billion board feet. This amount of harvesting and mill processing created many jobs over the years as further discussed in the FEIS for the Willamette National Forest Plan on pages III-213 to 235.

This timber harvest helped to supply the two mills that existed in the Oakridge/Westfir community. From 1924 to 1982 mill facilities existed in the City of Westfir. This mill site was abandoned after a series of fires which consumed most of the structures on the site. A mill built by the Pope and Talbot Company in the 1940's also existed in Oakridge until it was closed in 1989. The community immediately adjacent to this watershed still contains a number of people who make their living cutting, yarding, or hauling trees or working for the Forest Service in a timber production capacity.

ISSUES /

KEY QUESTIONS

CHAPTER II

ISSUES AND KEY QUESTIONS

Introduction

Issues and Key Questions have been developed to identify the variety of uses and values associated with the watershed and to focus the analysis on those elements of the ecosystem most relevant to management questions (USDA, USDI, 1995). The issues identified in this Watershed Analysis are all focused around past, current, or expected future management activities occurring in the watershed and how those activities may have affected the current conditions and reference conditions as discussed in Sections III and IV of this analysis. It was recognized that regardless of physical characteristics there would be little potential for negative or positive effects and hence little need (other than procedural) for this analysis or the recommendations it might make, if only natural processes and events were occurring in the watershed. Of course, the activities occurring in the watershed do influence, and are influenced by, the physical, biological, and social characteristics described in this analysis in Sections I, III, and IV. Since each Issue (activity) may, and often does, affect a number of resources, there is a certain amount of overlap in discussions of these effects.

These issues were also focused on activities rather than on resource conditions because the main purpose of this analysis is to facilitate, direct, and support management activities and decisions, both by providing decision-makers with current resource information with which to make the most informed decisions, and by giving decision-makers an idea of the importance or priority of various potential management activities. Individuals who will use this analysis during project development should find this analysis to be user-friendly since they will be able to find direct reference to the activities they are contemplating rather than having to sort through a number of resource discussions to find references to the need for or impact of the activity(ies) in question.

Key questions have been developed for each issue. These are questions that need to be answered in order to facilitate an understanding of how management (human activities) may affect the processes occurring in the watershed. They are also those questions which most need to be answered in order for decision-makers to make fully informed decisions as to whether and to what extent various management and social activities should occur within this watershed.

Key questions are answered in the last two sections of this analysis: Interpretation and Recommendations. These conclusions are a synthesis, by issue, of the Current Conditions (Section III.), Reference Conditions (Section IV), and the answers to the Key Questions.

Issue #1

Intensity and pattern of vegetation manipulation related activities.

Timber harvest, the most prevalent vegetation management activity, had been occurring in this watershed over the past 70 years to provide lumber, resulting in a substantial economic benefit to local communities and the nation as a whole. Timber harvest and associated slash burning/disposal, reforestation, and precommercial thinning, in addition to vegetation manipulation done for wildlife habitat enhancement (such as forage enhancement activities like brush cut-back, seeding, and fertilizing) have played a significant role in shaping the vegetation patterns within this watershed. Of all the activities that manipulate vegetation, timber harvest in all its forms has had by far the largest role. The landscape patterns resulting from this vegetation manipulation may be considerably outside the range of conditions resulting from wildfire, the most significant natural modifier of vegetation in this watershed. In addition to the pattern of disturbance, the intensity of these activities, (or the percentage of the watershed affected per time period) may exceed the average natural level of disturbance for a similar time period by a factor of two or more. Continuation of past harvest intensities could ultimately result in low amounts of forest being in a mature stand condition at any given time in certain areas within the watershed. The distribution of vegetation manipulation activities across the landscape, especially harvest of timber, may have had a profound effect on the amount of interior habitat through fragmentation of late-successional forests and isolation and/or removal of riparian forests. This may affect the dispersal of organisms across the landscape by reducing connectivity and caused a net reduction of late-successional forest due to edge effects.

The intensity of application (or rotation length if you will) for these vegetation management activities (again, especially timber harvest) may have had a profound effect on processes within this watershed. The amount of regeneration harvest implemented has been 32 percent over the past 70 years of management as compared to an average of 15 percent of stand replacement wildfire over the same period prior to management. This amount of vegetation disturbance has, to a certain extent, affected surface erosion and mass movement rates, increased peak stream flows, decreased water quality in a variety of ways, changed water yield, and have changed stream channel conditions, processes, and aquatic resources in general , and ultimately would eliminate late successional forests on all but those acres reserved from harvest (such as wilderness and other non-harvest allocations and reserves).

The intensity of management has also tended to simplify the structure of remaining or newly regenerated stands within and outside of riparian reserves and including stream channels. Most or all the large woody debris has been removed from some harvested stands. Regenerated stands were often, especially in the early years of harvest, planted densely to avoid reforestation failure. They were also typically planted with fewer species than occurred on the sites prior to harvest. Precommercial and commercial thinning have also tended to homogenize stands by making the tree spacing, diameter, and species distribution more uniform. Where late-successional forests still exist, some have been salvaged such that there are few snags and down logs remaining on the ground or in streams or certain species, as Pacific yew, were removed such that the remaining stands are simpler in composition than natural stands tend to be.

ISSUE #1 KEY QUESTIONS

1) Given current Forest Plan (as amended) land allocations, where and how many acres are available for vegetation manipulation (especially timber harvest)?

2) How has the intensity and pattern of vegetation manipulation (as compared to the change from prehistoric conditions) affected plant and animal habitat diversity, species composition, species viability, amount of interior habitat, habitat connectivity?

3) How has the intensity and pattern of vegetation manipulation (as compared to the change from prehistoric conditions) affected site productivity?

4) Where and to what extent has the change in spatial and temporal distribution of vegetation influenced the potential for water yield, water quality, and peak flow changes? Where have these changes in hydrology affected channel function and habitat condition?

5) What are the most important delivery mechanisms for sediment generated by vegetative disturbances in this watershed? What are relative rates of delivery by landform or slope to stream? Where are the high risk areas?

6) Where and to what extent has removal of existing and future sources of large wood material in stream channels changed the routing of sediment and in-stream habitat?

7) Where and to what extent has vegetation manipulation affected riparian habitat?

Issue #2

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

Fire suppression has been occurring for the last seven decades in this watershed. Given the amount of land affected by fire over the last few centuries (see the fire frequency discussion under Issue #1), this suppression effort has so far effectively eliminated wildfire as a major shaper of vegetational landscape patterns and processes. This exclusion may have had a number of vegetational effects across the landscape; meadow sizes and abundance have been shrinking as trees encroach upon them, forest structure may have become more complex in some areas, the landscape distribution of natural forest age classes may have become less diverse in some areas, fire dependent species may have declined (such as lodgepole pine, Montia diffusa, and Astragalus umbraticus. Fuel loading across the landscape may have increased in some areas. However, as described in Issue #1, other areas have been treated with activities that reduce fuel loading.

The effects of fire exclusion on the vegetation in this watershed may have several negative consequences on long-term landscape processes. Increasing fuel accumulations will ultimately result in more frequent, more severe, larger, and less suppressible wildfires. This may be of special concern within the LSR where there is much less opportunity for vegetation management activities to modify fuel accumulations and where there is or will be more contiguous fuel beds accumulating. Continued fire exclusion could also result in an increase in insect and/or disease outbreaks on harsher sites where dense stands may develop in the absence of fire and changes in long-term site productivity, positively as more organic material accumulates and negatively as fires burn more intensely. Fire exclusion may also have increased the habitat available for T E and S species such as spotted owls as forests develop more complex structurally in terms of understory layers and snag and down wood accumulation due to fire exclusion, but there could also be some long-tern detriments to late-successional habitat if wildfire extent and severity increase due to fuel accumulation.

ISSUE #2 KEY QUESTIONS

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.

2) If we provided for prescribed fire within established forest stands (as opposed to bare ground for site preparation) in order to reduce high fuel loading, and to bring the landscape fuel loading back to a natural range of variability, under what conditions could we control the fire? How many acres (per period of time) could need to be burned (by land allocation) and remain within air quality limits?

3) Under a prehistoric (pre-fire suppression) fire regime, what would the habitat diversity look like?

4) How would disturbance mechanisms associated with prescribed fire affect TE&S species, as well as fire dependent species?

Issue #3

The density and conditions of roads and trails has altered the landscape processes.

This watershed currently contains 570 miles of system and non-system roads and 160 miles of maintained trails. Approximately 6 miles of these road are seasonally closed for a variety of reasons, the most common of which is to avoid traffic related wildlife disturbance. Approximately 2 additional miles of road is closed year around except for administrative use (especially fire suppression). This extensive road system is for the most part a direct result of past timber harvest as discussed in Issue #1 but this system also provides for administrative access including that for fire suppression, and recreational access. The roads in this system were general designed for a 20 year service life. For many roads this designed service life has been exceeded and the road surface, ditches, and/or culverts are beginning to deteriorate. The Northwest Forest Plan ROD specifically prescribes that road densities in key watersheds remain at current levels or be reduced and that drainage structures be designed to accommodate 100 year return peak flows.

Like timber harvest, roads remove vegetation and hence can also increase peak flows as discussed under Issue 1 and by providing for more efficient slope drainage. Road may also increase the amount of mass movement magnitude of peak stream flow as roads often intercept and re-direct the overland and sub-surface flow of water. Such hydrologic effects can also eliminate or create wetlands or change the hydrologic character of special habitats (for example the drainage of a moist meadow). Roads can also affect the connectivity of habitats; they fragment habitat for organisms that find it difficult to cross small, bare openings and due to the often impassable nature of stream culverts. Roads also can be a disturbance vector for wildlife sensitive to noise or human presence.

As much as an extensive road system may create some detrimental environmental conditions, the extensive access opportunities can also have some beneficial impacts in providing large areas for various recreational activities such as hunting, dispersed camping, access to trailheads, and driving for pleasure. Road closures can limit these opportunities and concentrate use in areas with more open roads which in itself could potentially create resource problems. Local economies can also be affected, both positively an negatively, by increasing or decreasing the amount and ease of access, by changing traffic patterns, recreational uses, or the availability of firewood and special forest products.

Maintaining the current road system is also a fairly expensive proposition. There is not now money available to keep all system roads maintained for safe and pleasant use and roads that are not properly maintained can cause some fairly serious resource problems such sediment delivery to streams from as ditch and roadbed erosion. A portion of this road system is deteriorating and no funds are now available for proper maintenance. Maintenance needs, including culvert upgrading, for this road system need to be prioritized to most effectively make use of the limited maintenance funds. The Northwest Forest Plan standards and guidelines also require that existing culverts, bridges, and other stream crossing structures which pose a substantial risk to riparian conditions are to be improved to accommodate at least a 100 year flood event. Most stream crossing structures do not meet this design criterion and correcting this situation would entail a substantial cost that is not now funded.

There are also about 52 miles of non-system road that do not meet current standards for management. Recovery and growth of riparian vegetation immediately upstream from bridges and large culverts could result in the accumulation of large amounts of woody debris which could ultimately affect the viability of the stream crossing structure as well as down-stream resources should the bridge or culvert fail as the result of debris accumulation.

Trails, though they do not have the actual or potential effects that roads can have on resource conditions, may also contribute some sediment to the stream system. Trail use may also degrade water quality. Trail maintenance funds are also limited and several historic trails have been abandoned due to lack of use (due in large part to the fact that roads typically have cut these trails into several to many segments) and/or lack of funding. User conflicts also have occurred along some trail segments, particularly related areas where trails pass close to or through dispersed camping sites. Such conflicts have been addressed in the North Fork Wild and Scenic River Plan. There are opportunities to provide more trail use opportunities (for foot, horseback, bicycle, and trailbike use) when deciding which roads should be closed and how to close them.

ISSUE #3 KEY QUESTIONS

ROADS

System and Non-System

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

2) What sections of roads are currently or potentially introducing excessive amounts of sediment to the stream system? Where and to what extent does the influx of sediment influence channel conditions?

3) Where and to what extent has the density and configuration of roads affected surface and subsurface hydrology (i.e. wetlands, expansion of the drainage network, etc.)?

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

5) Since funding is no longer available to maintain the entire existing road system to designated levels, what are the potential resource effects of not maintaining all the roads in this road system?

6) Where and to what extent have roads (especially Aufderheide Drive) affected habitat connectivity and riparian reserves?

7) Where and to what extent have roads affected wildlife populations (points to consider: disturbance, poaching, etc.)?

8) Where and to what extent have roads affected special habitats?

TRAILS

9) Where and to what extent has the condition and use of trails influenced disturbance (i.e. surface erosion, slope movement, landslides)?

10) Where and to what extent are the trails and their use affecting wildlife and botanical values and where and to what extent have wildlife and botanical values affected trail use (via resource protection closures)?

ACCESS

11) How does changed access influence potential human caused fire ignitions and suppression response time for all fires (change in NFMS results)?

12) How does changed access affect public and administrative use of forest and local economics? (include abandoned trails and historic sites)

Issue #4

The introduction and spread of non-native species is affecting the native flora and fauna.

A number of plant and animal species have been introduced into this ecosystem during the period of European occupation. Some species have been introduced accidentally or on purpose by past livestock grazing, some for revegetation and erosion control along roads and other bare soil areas, some for human use and consumption.

These non-native species can and do cause a range of negative effects from supplanting or preying upon native species to impeding travel of human and wildlife. Some species may also have beneficial effects; they may serve as forage or a prey base for native species, provide for human hunting or gathering opportunities, or can be used to control other non-native species that are producing negative effects. There is particular concern when the presence of these non-native species affects the viability of threatened, endangered or sensitive species such as the Oregon chub and the western pond turtle.

Many of these species are continuing to expand their range in this watershed and have the potential to eventually overwhelm some native plant and animal communities. Roads and trails may be the vector of some of this expansion as seed may be transported by livestock, vehicles, or their occupants. The existence and spread of these plants and animals have the potential to affect recreation use, the economics of forest product utilization, or economic values on adjacent private lands (weeds in agricultural lands for example).

There is a potential for non-native fish species to migrate up the North Fork from the Middle Fork now that the Westfir Dam has been removed. It is not though that species such as crappie or large mouth bass would move upstream due to low water temperatures.

ISSUE #4 KEY QUESTIONS

1) Where and to what extent has introduction of non-native species affected native flora and fauna?

2) What is the social, biological, and economic effect of introduced non-natives?

Issue #5

Need to restore and maintain the habitat for future reintroduction of salmon and bull trout.

Spring Chinook salmon, steelhead trout, and bull trout have been eliminated from this watershed. It seems likely that some time in the future (but not immediate future), salmon and steelhead passage over existing dams will be provided. The habitat available to these fish in that event is not now of as high a quality as it once was. Opportunities exist to develop higher quality habitat such that any future reintroduction's would be more successful and provide for a maximum number of surviving individuals.

Of particular concern is the existence of stream channels with complex enough structure to provide for spawning habitat and juvenile rearing habitat. Some structural elements already exist and opportunities exist to create additional structures. Existing barriers to upstream fish movement may also be removed. Competing or predator species may have to be managed to provide for future successful reintroduction.

Such reintroduction's would have some positive social and economic impacts in terms of providing more diverse and economically attractive recreational activities, in addition to a potential increase in local community property values and an increase in the number of fish available for harvest downstream and in the ocean. Reintroduction of salmon, steelhead trout, and bull trout could also create some negative effects such as increased recreational impact in riparian areas, conflict between river users (specifically kayak and raft users) and the creation of in-channel structures.

ISSUE #5 KEY QUESTIONS

1) What are the potential social and economic effects of habitat restoration for and re-introduction of salmon, steelhead trout, and bull trout?

Issue #6

There is a demand for products from forest land (other than timber).

Commodity extraction not associated with the harvest of conventional timber products has been occurring in this watershed since humans have entered the area. These commodities include a large number of forest plants typically referred to as Special Forest Products (the ones most commonly harvested tend to be beargrass, ferns, salal, mushrooms, boughs, cones, Christmas trees, seeds and prince's pine, scion and cone collections for genetic improvement programs); in addition to mining for rock, minerals, and metals; extraction of water for municipal use (including sewage disposal); firewood;

quarry rock; post and poles; cedar bolts; and specialty woods. Demand for some of these products has increased in recent times and may continue to increase in the future. Current or future levels of use could cause resource impacts. Extraction of these products within certain land allocations such as LSRs and riparian reserves may not be compatible with land management goals.

ISSUE #6 KEY QUESTIONS

1) Where are forest products (other than timber) located in the watershed?

2) Are there conflicts between this product extraction and meeting land management objectives and where and to what extent is harvest of these products appropriate?

Issue #7

There is an existing infrastructure in this watershed that may have an effect on watershed values and processes.

A number of administrative, community oriented, and industrial infrastructure facilities, some associated with special use permits, occur within this watershed. These facilities include but are not limited to railroad, power line, and road rights-of-way, developed recreation sites (five campgrounds and Aufderheide Drive interpretive sites), a water treatment plant, residences on federal land, two fire lookouts, a guard station, stream gauging stations communications site, various helispots, numerous dispersed recreation sites, the historic Klovdahl tunnel at Waldo Lake, and various water sources used mostly for fire suppression and road maintenance. These uses may or may not have effects on the resource values contained in this watershed.

ISSUE #7 KEY QUESTIONS

1) Where are existing infrastructure land uses and where are additional uses likely to occur in the future?

2) Do the presence and use of these facilities affect the resources contained in the watershed, including riparian functions and water quality?

Issue #8

Waldo lake area access and travel management.

The methods and patterns of access within the Waldo Lake basin has become an area of key public concern over the past decade. The issue as to whether or not motors should be permitted on Waldo Lake was the single most mentioned issue specific to a particular location mentioned in public input to the 1990 Willamette National Forest Land and Resource Management Plan (Forest Plan). Gasoline powered motors are currently allowed on the Lake which has a speed limit of 10 miles an hour imposed by the State Marine Board. The debate as to whether motors should be used on the lake centers around the fact that the purity of Waldo Lakes water is unique on a global scale.

A number of diverse recreational uses occur in this basin, such as hiking, backpacking, cross-country skiing, horseback riding, mountain biking, snowmobiling, boating of all types on Waldo lake, lake-side dispersed camping, in addition to cars, trucks and RVs using the existing paved road system. These uses are often seen as conflicting and some may have resource impacts, especially if recreational use in the basin increases in the future, which is considered to be very likely. The most common use conflicts in the basin occur between motorized and non-motorized travelers on both land and water surfaces (particularly on Waldo Lake itself and over-the-snow travelers) and between conflicting types of non-motorized travel (hiking with mountain biking with horseback riding). This use may also affect or has the potential to affect TE & S habitat, water quality in Waldo Lake, and air quality.

Restriction of certain types of access in some areas of the basin could limit or improve recreation opportunities (especially by reducing user conflicts or providing opportunities for the elderly or disabled), make administrative access more difficult, and affect the safe use of the Lake if rescue activities would be hampered by vehicle prohibitions. Changing access patterns could also improve recreational opportunities by minimizing user conflicts (such as those that typically occur between cross-country skiers and snowmobilers) and could also affect local traffic patterns to the detriment of local businesses (as in the potential effect on the communities of Crescent and Crescent Junction should the Charleton Butte road be improved).

ISSUE #8 KEY QUESTIONS

1) What are potential impacts from recreation use? (Noise, water and air quality, sediment, affect on TE&S and unique species, user groups)

2) What opportunities exist to better provide for a range of quality recreation experience with lesser amount of user conflict? (address access for all user groups)

3) What motorized and non-motorized boating opportunities exist within the immediate surrounding area?

4) What is need for administrative and emergency access?

REFERENCE & CURRENT CONDITIONS

CHAPTER III

REFERENCE CONDITIONS / CURRENT CONDITIONS

This section discusses the reference conditions, then current conditions, of various resource components of the watershed, presented in the same order and format as the Chapter II Characterizations discussion. These resource components are those relating to the issues presented in Section III. Reference Conditions are "the known or inferred history of the landscape...to explain how the existing conditions have changed over time as the result of human influence" (see USDA and USDI, 1995, page 24). Current conditions are "the current range, and distribution in conditions of ecosystem elements" in the watershed (see USDA and USDI, 1995, page 22). These two discussions have been combined to better illustrate how a given resource has been affected by past natural events, human use, and management activities. These discussions also give an overview of the processes occurring in the watershed.

Since very little resource information was collected in areas like the North Fork Watershed prior to the commencement of management activities at the beginning of this century, very little data exists with which to absolutely quantify reference conditions. In many cases the reference condition narratives to follow present what is believed to have existed based upon the events known to occur that would have influenced the various resources discussed below.

Physical

GEOLOGY

SITE PRODUCTIVITY

SURFACE EROSION

Reference Conditions

Naturally occurring stand replacement fires are probably the closest comparison that can be made for relating timber harvest (particularly clearcut harvesting) with pre-historic conditions. As discussed under the Fire History section of Chapter II, Watershed 17 is characterized by isolated stand replacement fires that were limited in extent and created a patchwork landscape. Large scale stand replacement fires are thought to have a recurrence interval on the order of 400 years. On the other hand, the upper end of Watershed 24 is characterized by large stand replacement fires with a recurrence interval on the order of 60 years.

Loss of canopy closure and duff layers due to high and some medium intensity fires would allow relatively unimpeded rainfall impact upon the soil. This can result in overland flow, which can mobilize soil particles detached by raindrop impact.

These fires tended to remove underbrush and kill mature trees, creating abundant snags. For a number of years following the fire, the areas would be in the process of reestablishing fine roots as the underbrush and seedlings developed. As dead trees fell, they provided energy dissipaters to overland water flow, thus limiting transport distance for downslope movement of soil.

Current Conditions

In Watershed 17, approximately 8600 acres have been clearcut harvested on soils considered to be severely erosive. The vast majority of these have been on steep ground.

Table 1: Acres Clearcut in Severely Erosive Soil by Decade

	Decade of harvest						
Subwatershed	1940 - 1949	1950 - 1959	1960 - 1969	1970 - 1979	1980 - 1989	1990 - 1995	Totals
17-1	0	240	570	312	415	142	1679
17-2	260	98	536	437	777	67	2175
17-3	126	367	639	700	639	34	2502
17-4	2	445	231	365	320	0	1363
17-5	0	62	293	173	351	0	879
Totals	388	1212	2269	1987	2502	243	8601

In Watershed 24, approximately 461 acres have been clearcut harvested on soils considered to be severely erosive. Most of this has occurred since 1980.

Table 2: Acres Clearcut in Severely Erosive Soil by Decade

	Decade of harvest				
Subwatershed	1960 - 1969	1970 - 1979	1980 - 1989	1990 - 1995	Totals
24-1	39	4	355	63	461
24-2	0	0	0	0	0
24-3	0	0	0	0	0
Totals	39	4	355	63	461

Further refinement of location for acres harvested on severely erosive soils by decade is included in Appendix B.

Management practices relative to the retention of large woody material (LWM) has varied with time. Areas harvested during the period when most LWM was removed from the harvest units (mid 1970's to mid 1980's) have the greatest potential for downslope erosive movement of soil. As mentioned previously, the presence of LWM tends to dissipate the energy of surface flow and reduce downslope soil movement. The greatest potential impact would be in the areas listed above which have severely erosive soil adjacent to streams.

COMPACTION

Reference Conditions

There was very little compaction of soil prior to the beginning of timber harvest and road building in the 1920's aside from the very localized and small amount of compaction caused by trails used by humans, wildlife, and the potentially more widespread and more sub-surface compaction caused by glaciation.

Current Conditions

Tractor yarding was used extensively prior to 1980 on gentle slopes (usually less than 35%). It is estimated that approximately 14,000 acres were harvested in Watershed 17 using tractor yarding. Large tracts of land were tractor logged on Christy Flats, the south slopes, and Grassy Creek.

Isolated blocks were tractor logged in the early timber management within Hamner, Sardine, evangeline and Billy Creeks.

Approximately 3000 acres have been harvested on high clay content soils in Watershed 17. Even with partial suspension cable logging systems, this ground is prone to moderate to high impacts, whether it be gouging or compaction.

Compaction due to tractor logging in Watershed 24 is confined primarily to the harvest units within and adjacent to the North Fork riparian area corridor. This is primarily due to the fact that the valley bottom in the lower portion of Watershed 24 has gentle slopes (less than 35%) located adjacent to the main stem of the North Fork.

LANDSLIDES ASSOCIATED WITH VEGETATION CHANGES

Reference Conditions

The reference condition for naturally occurring landslides is discussed under Issue 3, Question 1 in Chapter IV, Interpretation. As discussed, at this level of analysis it is unlikely that a realistic assessment of the frequency and distribution of naturally occurring landslides can be made in reference to pre-historic processes such as fire. This is due to the fact that aerial photo reconnaissance can identify areas subject to debris slides, but cannot make a determination as to whether it occurred during the last stand replacement fire or the previous one. Therefore, extrapolation of observations made on older photo sets in unmanaged areas were be used for the Reference Condition. Additionally, the high elevation aerial photos used are of relatively low resolution and small events are not always evident.

Seven naturally occurring landslides were noted from aerial photographs in Watershed 17 and none in Watershed 24.

Current Conditions

For purposes of this analysis, two types of landslide mechanisms will be used to compare the reference condition and current condition: debris slides and deep seated landslides. The typical setting for debris slide initiation is steep ground with shallow, rocky soil. For deep seated landslides, the typical setting is gentle to moderate ground with high clay content soils. The failure mechanism is usually less dramatic than with debris slides and therefore more difficult to identify using air photos. This geomorphic setting is sensitive to changes in the ground water regime. Like debris slides, removal of the forest canopy raises the ground water levels, thus increasing the potential for deep seated failure. Unlike debris slides, deep seated landslides are relatively insensitive to the effects of root strength. Additional information on mass wasting associated with stream side riparian areas is summarized under sections Aquatic - Subwatersheds in this chapter. These mass wasting sites associated with stream channels can be significant sources of sediment to the aquatic system and are often found where streams erode deep seated landflows.

In Watershed 17, approximately 13% of the area is characterized by deep high clay content soil. Approximately 3000 acres have been clearcut harvested since 1940. Of that, 370 acres have been harvested since 1980 which indicates that 370 acres of high clay content soil are in some stage of redeveloping pre-harvest ground water levels.

One harvest related landslide was noted during air photo reconnaissance spanning 1955 to 1991. This event was identified in the 1959 photos near the mouth of Hamner Creek.

In Watershed 17, approximately 53% of the area is characterized by steep ground with shallow, rocky soil. The probability of debris slide initiation is increased with a loss of live canopy and the resultant rise in ground water and the loss of root strength. Approximately 8600 acres have been clearcut harvested in this setting since 1940, with 2745 acres of that occurring since 1980. This means that 2745 acres of steep ground with shallow, rocky soil are in some stage of redeveloping pre-harvest root strength and ground water levels, therefore at an elevated risk of producing a debris slide. In Watershed 24 however, no harvest related debris slides were noted from aerial photography spanning 1955 to 1991. This is well below the reference condition of 7 naturally occurring events in Watershed 17.

In Watershed 24, approximately 37% of the area is characterized by steep ground with shallow, rocky soil. Approximately 460 acres have been clearcut harvested in this setting since 1960, with 400 acres of that occurring since 1980. This means that 400 acres of steep ground with shallow, rocky soil are in some stage of redeveloping pre-harvest root strength and ground water levels and is therefore at elevated risk of producing a debris slide.

In Watershed 24, deep seated landslides would not be a factor due to the lack of deep, clay soils. No harvest related landslides with a deep seated failure mechanism were identified.

LANDSLIDES RELATED TO ROAD CONSTRUCTION

Reference Conditions

As mentioned under the Characterization for Geology and Soil, the North Fork Watershed can be roughly divided into three geomorphic settings: Waldo Basin, Upper Valley and Lower Valley. Following is a description of the potential slope failure mechanisms inherent to each area as well as identification of areas that show evidence of naturally occurring slope movement.

Although the following discussion is based on geomorphic subdivisions which are independent of watershed and subwatershed boundaries, specific slope failures are reported by watershed. More specific locations (subwatershed and PSUB) are noted on the slide occurrence inventory included in Appendix C.

The time frame used for establishing the Reference Condition is roughly 100 years before present. 1955 and 1959 aerial photos were used for this baseline in areas which had not been affected by management activities. Extrapolation of this data was applied to areas which had management activities (road construction and timber harvest) prior to that time.

This time frame was chosen because some of the slope movement processes which have occurred during the Holocene are episodic (not periodic) and occur with decreasing frequency after large scale disturbances such as glacial retreat. For instance, we know that the tension crack known as Hell Hole (located in subwatershed 172) will result in a large scale, catastrophic slope collapse at some time in the future. Similarly, debris chutes within the Upper North Fork have had debris slides associated with them at least once, but if they did not show response to the 1964 flood and did not impact vegetation on the midslopes, it is not known whether they moved 100 years ago or longer. These events that occurred more than 100 years ago therefore are not a valid measure of the effects of management activities.

Waldo Basin

This area includes Subwatersheds 24-2 (excluding the northwest portion) and 24-3. The northwest portion of Subwatershed 24-2 is more similar to the description of the Upper Valley.

The Waldo Basin is characterized by slopes less than 40%, granular soil composed of volcanic ejecta and glacial till and numerous rock outcrops. This area is very stable in terms of landslide potential. The surface soil is erosive, however the gentle topography and porosity tends to localize the effect.

No naturally occurring landslides were noted within this area.

Upper Valley

This area includes Subwatersheds 24-1, the northwest portion of 24-2, and the eastern half of 17-2. The western half of 17-2 is more similar to the description of the Lower Valley.

The Upper Valley is characterized by U-Shaped valleys resulting from alpine glaciation. The wide valley bottoms are composed of alluvium and glacial till and is very stable in terms of landslide potential. The lower side slopes are composed of glacial till and colluvium and are stable. Slopes range from 20 to 50%. The upper slopes tend to be steep (60 - 90%+) and have shallow, rocky soil overlying andesitic and basaltic lava flows. Approximately 61% of the Upper Valley is characterized by this geomorphic setting. The dominant slope failure mechanism tends to be debris slides initiating on steep ground. Many pre-historic debris chutes were noted, but evidence of recent movement is lacking.

No naturally occurring landslides were noted within this area that could be positively identified as having occurred within the past 50 years.

Lower Valley

This area includes Subwatersheds 17-1, 17-3, 17-4, 17-5 and the west half of 17-2. The eastern half of 17-2 is more similar to the description of the Upper North Fork.

The Lower Valley is characterized by older, more dissected terrain dominated by rock of pyroclastic origin. Slopes tend to be locally variable, ranging from gentle earthflow landforms with deep soils to steep headwalls with shallow soils.

Approximately 13% of the Lower Valley is characterized by soil with a significant amount of clay. These landforms tend to be naturally unstable, although a distinction needs to be made between past active / currently stable and past active / currently unstable. The former tends to have localized instability adjacent to streams and at significant slope breaks (Tumble Creek earthflow), whereas the latter is unstable over a larger area (Chalk Creek earthflow).

Approximately 63% of the Lower Valley is characterized by steep ground with shallow, rocky soil. This setting tends to be stable, but contains erosive soil and is prone to debris slides.

Seven naturally occurring landslides were noted in the Lower Valley. Three were associated with high clay content soil and four were associated with steep ground with shallow, rocky soil. Of these seven, four occurred in the Hammer Creek drainage, two in the Chalk Creek drainage and one in the High Creek drainage.

Current Conditions

Waldo Basin

No slope failures associated with road construction were noted. This is due to the fact that only 0.36 miles of road have been constructed on steep ground with shallow, rocky soil and no soils with clay occur in this area.

Upper Valley

Approximately 40 miles of road have been constructed on steep ground with shallow, rocky soil. One slope failure associated with road construction was noted in the files, however this slide was a localized fill slope failure and did not impact ground outside the clearing limits of the roadway.

Lower Valley

Approximately 38 miles of road have been constructed in high clay content soil on fairly gentle slopes. Eight road related slope failures associated with road construction were noted in the files and were confined within the clearing limits of the roadway and stabilized. Three exceptions to this were Camp Five Slide; a slide at Road #19, mile post 13 that affected the North Fork; and Road #1920, mile post 2.3 that affected McKinley Creek. All three of these slides have been stabilized.
Approximately 186 miles of road have been constructed on steep ground with shallow, rocky soil. Twenty-seven road related debris slides were noted on air photos, with all but one associated with sidecast construction during the 1950's and 60's. Impacted creeks include the North Fork itself (3), the stream west of Short Creek (5), Short Creek (2), Dartmouth Creek (3), Chalk Creek (3), Billy Creek (1), Purdue Creek (1), Christy Creek (4) and Grassy Creek (1). A listing of identified slope failures is included in Appendix C.

As mentioned earlier, the majority of the debris slides were associated with sidecast construction techniques on steep ground. Road construction standards changed in the late 70's and sidecast construction techniques were halted. Roads built using these standards tend to fail in two episodes: Soon after construction, and roughly 20 years after construction when organic debris buried in the fills decomposes. Little is known about the distribution of the current affects of this second episode. Since most of the road system was in place by the late 70's or early 80's, it is reasonable to expect that outside edge cracking of the older road system is currently taking place.

Table 3: Debris Slides and Affected Creeks

Creek Name	Naturally Occurring	Road Related
North Fork Middle Fork	0	3
West of Short Creek	0	5
Short Creek	0	2
Dartmouth Creek	0	3
High Creek	1	0
Hamner Creek	4	0
McKinley Creek	0	1
Chalk Creek	2	2
Billy Creek	0	1
Purdue Creek	0	1
Christy Creek	0	4
Grassy Creek	0	1

<u>ROAD / STREAM CROSSINGS</u>

Reference Conditions

Reference condition for road / stream crossings are those prior to significant road construction related to commodity extraction. Primitive roads that may have existed prior to that time were likely to have utilized low water fords or log stringer bridges that had little effect on water flow or fish migration.

Current Conditions

Approximately 930 culverts have been installed within the watershed where roads cross Class 1 through 4 streams. At least 3 or 4 times that amount of culverts exist when ditch relief culverts are considered. Many of the culverts for class I and II streams were not designed for upstream fish migration or if they were many have lost that ability due to outlet scour or are no longer viewed as adequate due to changes in velocity and length design requirements. In addition, most culverts were originally designed to carry a 50-year flood event rather than a 100 year event, if they were hydraulically designed at all.

Table 4: Frequency of Road / Stream Intersections

Subwatershed	Class I	Class II	Class III	Class IV	Total by Subwatershed
17-1	4	28	23	129	184
17-2	8	42	34	159	243
17-3	0	27	13	157	197
17-4	2	8	11	128	149
17-5	2	6	11	62	81
24-1	1	14	3	71	89
24-2	0	0	0	0	0
24-3	0	0	0	0	0
Totals by Stream Class	17	125	95	706	943

Inventory and analysis of 31 culverts within the watershed indicates that 29% will overtop the fill during a 100-year flood event. All of the 31 culverts are located on Rd. 19, adjacent to the North Fork. This value is lower than the findings for 153 culverts analyzed on timber sale haul routes on Oakridge and Rigdon Ranger Districts (40% undersized). However, the culverts analyzed on Rd. 19 were limited to Class 2 and 3 channels primarily and represents less than 1% of the total culverts within the watershed.

Analysis methods used assumed 100% efficiency for hydraulic carrying capacity of the pipes. Inlet damage or plugging was not accounted for, but can have a significant effect. Of the 31 culverts analyzed, 42% had more than 5% of the inlet area plugged with soil or organic material.

The Oakridge Ranger District Watershed Improvement Needs (WIN) inventory indicates the flow capacity of a significant number of culverts is reduced (see Table 5) and may fail during a high runoff storm event. See section Social - Roads - Current Condition for related information.

Table 5: Partially Plugged Culverts (WIN Database)

Subwatershed	Total Culverts	Partially Plugged	% Partially Plugged
17-2	823	221	27 %
17-3	736	329	45 %
17-4	353	146	41 %
17-5	310	122	39 %

AQUATIC

STREAMS

CLASSIFICATION AND DISTRIBUTION

Reference and Current Conditions

The amount and distribution of streams vary across the watershed due to changes in site specific characteristics including soil properties and geology. Table 6 of this chapter displays the number of stream class miles by watershed and class. Class II stream mileage includes intermittent streams utilized by fish at least a portion of the year. Stream mileage and density for all classes of stream are significantly higher in the Lower North Fork (Watershed 17) when compared to the Upper North Fork (Watershed 24). Appendix D displays the variation in stream density by subwatershed.

Table 6: Stream Miles by Class

Stream Class	Lower N. Fork Watershed 17	Upper N. Fork Watershed 24	Total Miles
I	36	18	54
II	102	26	128
III	82	41	122
IV	369	115	484

The gradient of the North Fork varies from very high in its headwater reaches located in the high Cascades to low to moderate gradient near its confluence with the Middle Fork. Tributary streams to the North Fork are moderate to high gradient (generally greater than 5%) with a step bed morphology. The Main stem of the North Fork and many tributaries have a substrate composed primarily of cobbles and boulders contributing to a predominantly riffle stream habitat types. Individual steps in tributary streams are also frequently formed by water flowing over in-stream large woody material and boulders.

STREAMFLOW

The runoff pattern generally is similar to the precipitation pattern discussed in Chapter II. The majority of the runoff occurs from November through May during periods of rainfall and snow melt. Lowest stream flows generally occur in the months of August and September. Snowmelt from the highest portions of the watershed contributes to the maintenance of summer base flows.

Reference Conditions

Flow measurement records from the U.S. Geological Survey (U.S.G.S.) at the outlet of Waldo Lake range from a low of 0 cubic feet per second (cfs) to a high of 143 cfs with an average flow of 35 cfs. The 65 year data record for the U.S.G.S. gauging station located near the mouth of the North Fork (this station was discontinued in September of 1994) indicates an average discharge of 783 cfs. The highest annual mean discharge of record was 1,201 cfs in 1972 and the lowest annual mean discharge was 350 cfs in 1977. The lowest annual seven day minimum flow was 93 cfs in 1940. Mean monthly flows range from a low of 163 cfs in September, to a high of 1,243 cfs during the month of December.

Major flood events occurred in 1861 and 1890 that caused extensive property damage in the downstream communities of Springfield and Eugene. Several major flood events have occurred this century the largest being in December of 1964 that had a recurrence interval of approximately 130 years. Other smaller though significant flood events of record which exceeded an estimated 10 year recurrence interval occurred in the month of December in years 1942 and 1945, and in the month of January in years 1953 and 1971.

Current Conditions

Due to the relatively large number of acres disturbed by harvest activities including road construction since 1950 (primarily in the Lower North Fork Watershed 17), relatively infrequent flood events since that time likely resulted in sediment delivery rates to stream channels above natural levels. Due to the mostly confined nature of the stream channels within the watershed and channel gradients, flood events of this magnitude would have sufficient energy to transport all but the largest sediment sizes delivered to streams.

PEAK STREAMFLOW

Reference and Current Conditions

Stream discharge is a result of a combination of climatic and site conditions and can be influenced by management activities. Variations in stream flow are influenced be the intensity, duration and type of precipitation, and the capacity of the watershed to store runoff. Peak streamflows are most likely to occur during storms delivering large quantities of precipitation in a short time. Warm wind and rain storms on saturated snowpacks can also contribute to flood events. The latter type of event is most common in the transient snow zone between the months of October and March. Increases in peak streamflow may result in an increase in stream bed and bank erosion and a corresponding increase in sediment production.

HYDROLOGIC RECOVERY

Reference Conditions

The vegetative condition of an area, as it relates to snow accumulation and melt is termed hydrologic recovery. Prior to forest management, hydrologic recovery values probably varied widely across the watershed. Because hydrologic recovery relates to how vegetation affects snow accumulation and melting within the transient snow zone, the concept is most relevant to Watershed 17 and the lower elevations of Watershed 24. Watershed 17 likely experienced long periods of relatively high hydrologic recovery punctuated with relatively short periods (depending upon how fast the area reforested) of very low recovery levels (similar to the effects of clearcut harvesting) after the very infrequent, landscape level fire events mentioned in the Vegetation/fire history discussion contained in Chapter II.

Current Conditions

Hydrologic recovery can be quantified by the Aggregate Recovery Percent (ARP) method. Calculated ARP values were used as a measure of the risk of increased peak streamflow related to management activities for each of the watershed analysis areas. For a further discussion of ARP, see Willamette National Forest LRMP FEIS Chapter IV, Section; Water and Appendix B of that document.

For planning purposes, the Willamette National Forest Land and Resource Management Plan (Forest Plan) describes the sensitivity of subdrainages based on overall slope of the drainage the percent in the transient snow zone. Each planning subdrainage was assigned a Midpoint ARP as a reference point for assessment purposes. The mid-point ARP values provide a relative measure of drainage sensitivity. These may be viewed as thresholds of concern below which there would be a higher risk of increased peak flows and associated adverse effects. Current and mid-point ARP values are displayed in Appendix E.

Forests within the lower North Fork (Watershed 17) have experienced the greatest intensity of timber management activities in the past. Therefore these stands have the greatest probability of being in a relatively low state of hydrologic recovery. The majority of the planning sub-drainage's are currently significantly above the mid-point ARP level. Three subdrainages in the lower North Fork are at or are within five points of the mid-point ARP level. These planning sub-drainage's include; Chalk (17G), Dartmouth (17B), and High (17D). The low recovery of these sub-drainage's is of special concern since they also occupy areas of deep, high clay content soils adjacent to streams capable of transporting fine sediments during high flows.

Roads contribute to an increase in peak flows above the change in vegetative condition primarily due to the reduced permeability of the road surface, more rapid routing of water to streams in roadside ditches, and interception and conversion of sub-surface flow to more rapid surface flow. Although road surface area was factored into the analysis of hydrologic recovery, an additional factor of road density should be considered when assessing an area's potential contribution to peak flows. Appendix F lists the current road densities by planning sub-drainage.

WATER YIELD

Reference and Current Conditions

Water yield of an area is a product of the amount of precipitation an area receives, combined with the soil and landform properties. The vegetative condition of an area also affects water yield due to changes in the evapotranspiration rates. Water yield increases have been observed following stand replacement wildfires (Potts et al.) and after clear cut harvesting (Moring 1975). As mentioned in the upcoming section on vegetation (see Table 21 of this chapter), management has not yet created significantly more acreage of early successional forest than would have existed under a natural fire regime. Therefore, water yields for reference and current conditions are within the range of natural variability, though harvesting and road construction may have changed the magnitude of peak flow events as previously discussed.

Groundwater storage capacity is directly related to the type of soil and its depth. Relatively shallow soils have a lower ability to store water and have the potential to be the greatest contributors to increased stream flow during high runoff events. Deep soil areas have the ability to store more water and release this water at a slower rate and contribute to baseflow. Soil water yield classification from the Willamette National Forest Soil Resource Inventory (USDA 1994b) were used as an indicator of the water storage capacity of the soil and the rate at which water would be transmitted through the soil contributing to streamflow. Soil water yield class definitions used in this analysis are as follows:

- I Soils with a low runoff rate and high water detention capacity, given that the soils are not saturated or frozen. Important in sustaining high base flows.
- II Soils with a moderate runoff rate and moderate water detention capacity. Water contributions to both peak flows and base flow.
- III Soils with a high runoff rate and low water retention capacity. The storage capacity is low and easily exceeded with most of the water contributing to peak flow. Little water yield to sustain base flow.

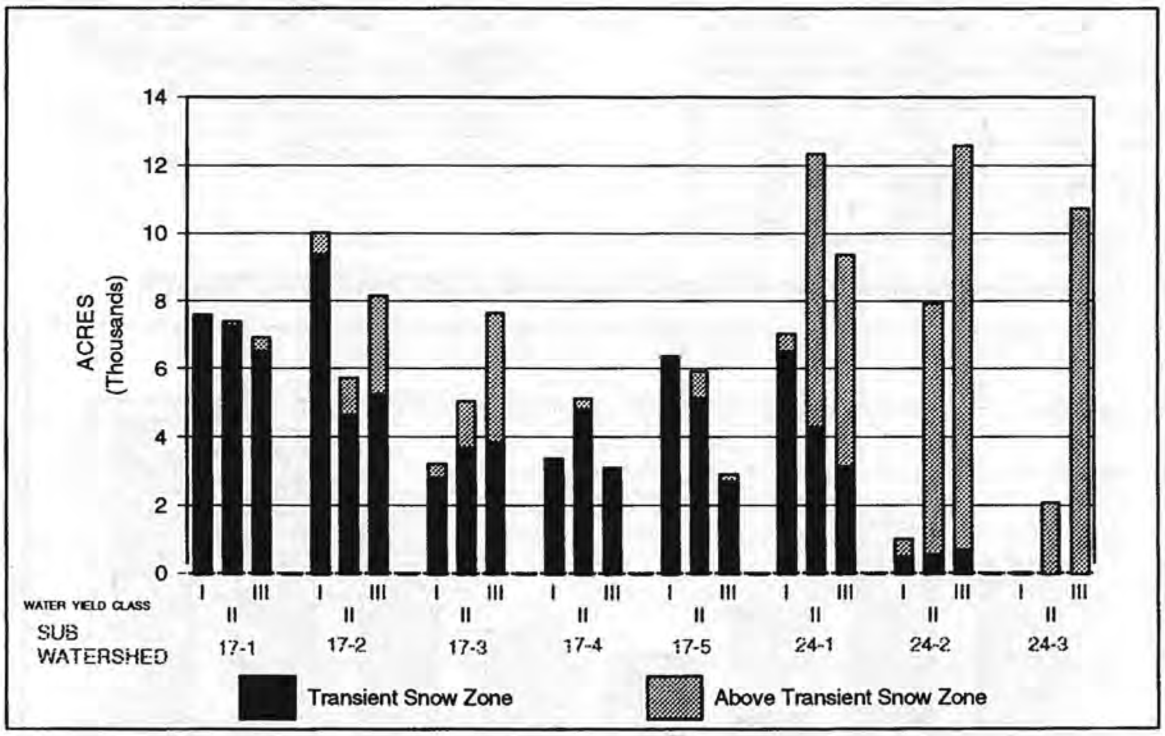
Landtypes identified in the Soils Resource Inventory were aggregated into high, moderate or low water yield classifications. Figure 1 of this chapter displays the relative percentage of each water yield class by subwatershed and the relative proportion of each subwatershed within the transient snow zone. Those subwatersheds that have a high proportion of their area in water yield class III and a high proportion of their area in the transient snow zone would be most susceptible to increases in peak stream flows associated with high runoff events.

LARGE WOODY MATERIAL

Reference Conditions

Large woody material is an important component of most stream reaches within the North Fork Watershed. This material influences the form and structure of stream channels by affecting stream profile, pool formation, and channel pattern and position. The rate at which sediment and organic matter are transported downstream is controlled in part by the retention of this material behind in-stream structures formed by LWM. The features formed by LWM affect the formation and distribution of in-stream habitat, provide cover and complexity, and act as a substrate for biological activity. Amounts of large woody material (LWM) in stream channels likely varied across the watershed. In areas affected by floods and debris torrents, large amounts of LWM would have been distributed in a non-uniform fashion, existing in large debris jam and isolated logs and trees. Some areas that experienced repeated fire (see the discussion of reburning in the vegetation/fire history section of Chapter I) may have had low amounts of in-channel large woody material. Photos of the North Fork taken immediately after the 1964 flood indicate large concentrations of LWM in and adjacent to the channel.

Figure 1: Water Yield Class by Subwatershed



Current Conditions

Past management activities such as salvage logging and stream cleaning projects have reduced the current amount of large woody material present in stream channels when compared to pre-management conditions. The 1964 flood event combined with extensive timber salvage within the riparian area of the North Fork likely had significant impacts to the stability of gravel and cobble bars, stream banks, and riparian vegetation. Aerial photography of the North Fork from later years combined with stream survey data indicates a large reduction in LWM in and adjacent to the stream channel. This loss of LWM is likely in part responsible for reduced channel complexity including a reduction in the number of pools and the number and length of side channels. See section Subwatersheds this chapter for a discussion of the current levels of in-stream large woody material by subwatershed.

Large woody material for streams originates directly from the adjacent riparian area, from tributaries, and from hill slopes. Past timber management activities have significantly affected this source area of LWM within the riparian areas. Stand replacement timber harvest and salvage logging has reduced the amount of LWM currently available and the potential recruitment of LWM in the future in the majority of subwatersheds particularly in the Lower North Fork (Watershed 17). Many decades will be required for riparian areas to recover and provide LWM of similar sizes and amounts as would have been available under pre-management conditions. Approximately 39% of the total area of the North Fork Watershed is within areas identified as riparian reserves. Table 7 and Figure 2 (both of this chapter) display the number of acres in riparian reserves by subwatershed and the percentage impacted by stand replacement harvest. Figure 3 of this chapter displays the acres of riparian reserve by the associated riparian designation and the distribution of harvest within these reserves by subwatershed.

Table 7: Acres of Riparian Reserves and Percent Impacted by Stand Replacement Harvest

Sub - watershed	Riparian Reserve Acres	Percent Harvested
17-1	7271	25
17-2	8415	35
17-3	5691	45
17-4	4277	50
17-5	5065	35

Sub - watershed	Riparian Reserve Acres	Percent Harvested
24-1	8770	10
24-2	11159	0
24-3	11367	0

Figure 2: Acres of Riparian Reserves and Amount Impacted by Stand Replacement Harvest

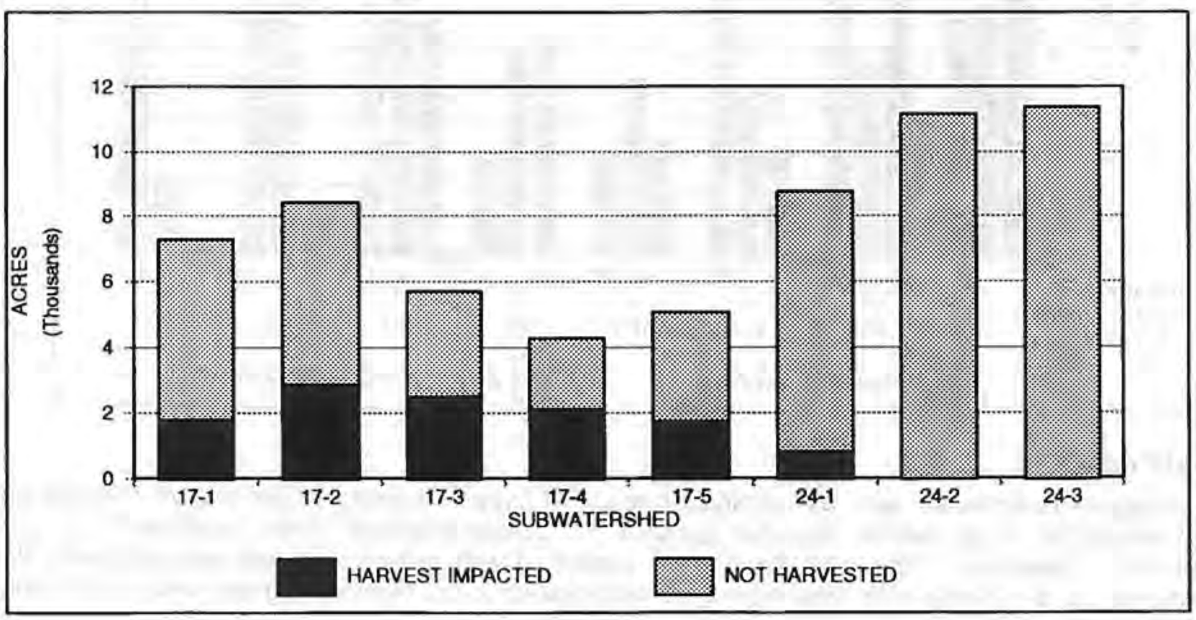
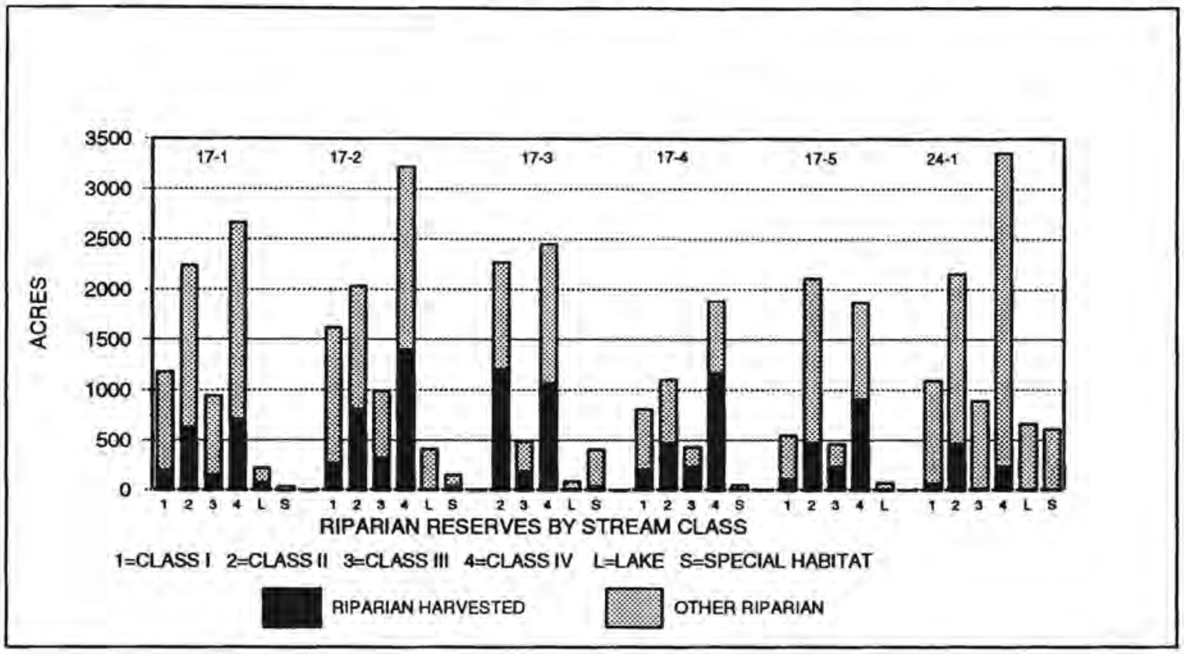


Figure 3: Distribution of Riparian Reserves by Type and Area Impacted by Stand Replacement Harvest



The area impacted by management activities within riparian reserves has varied over time. Harvest impacts within riparian reserves greatly increased during the decade beginning in 1960 and remained relatively high through the decade ending in 1990. See Figure 4 of this chapter for a display of the total area of riparian reserves impacted by stand replacement harvest by decade. Figure 5 of this chapter displays the area of riparian reserves harvested by decade and subwatershed.

Figure 4: Stand Replacement Harvest Within Riparian Reserves by Decade (all watersheds)

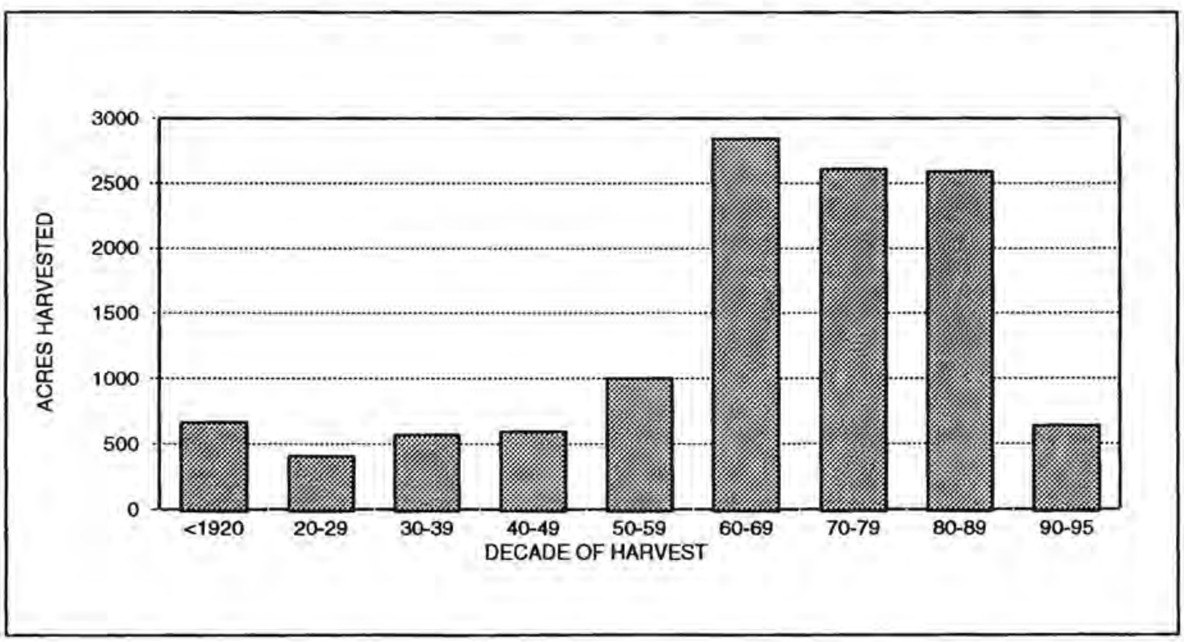
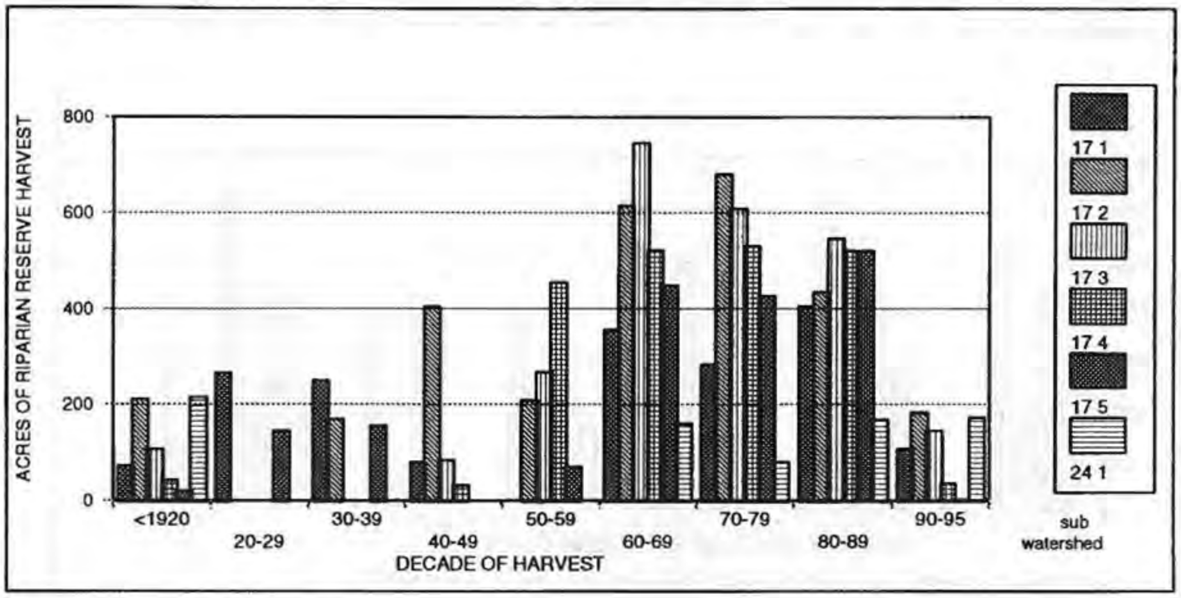


Figure 5: Stand Replacement Timber Harvest Within Riparian Reserves by Decade and Subwatershed



WATER QUALITY

STREAM TEMPERATURE

Reference Conditions

Some of the temperature information listed in the following table, for the North Fork and two of its tributaries, was measured before large scale management began and provides some indication of reference conditions.

Historic Stream Temperature Data

Location	River Mile	Date	Temp. in Degrees F
North Fork:			
Confluence with Middle Fork	0	8/31/37	54
Christy Creek	15	7/13/38	56
Brock Camp Highway Bridge	25	7/13/38	56
Skookum Creek	36	7/15/38	58
Christy Creek:			
Average of first mile	-	7/11/38	60
One mile above mouth	-	4/16/64 -- 10/9/64	43 -- 60
One mile above mouth	-	3/1/65 -- 9/1/65	44 -- 58
Fisher Creek:			
Mouth	-	7/15/38	54
Mouth	-	6/4/64 -- 10/9/64	43 -- 53
Mouth	-	3/31/65 -- 9/1/65	43 -- 52
One mile above mouth	-	7/15/38	53
Two miles above mouth	-	7/15/38	52

(from McIntosh, et. al., 1992.)

Current Conditions

For Salmonid fish producing waters, current Oregon Administrative Rules allow no measurable increases outside of the assigned mixing zone... when stream temperatures are 58 degrees Fahrenheit or greater; or more than 0.5 degrees F increase due to a single source discharge when receiving water temperatures are 57.5 degrees F or less; or more than 2 degrees Fahrenheit increase due to all sources combined when stream temperatures are 56 degrees F or less (OAR Chapter 340, Division 41 - Department of Environmental Quality). The state temperature standard is currently under review by the Oregon Department of Environmental Quality. The recommendations of the Policy Advisory Committee include the following changes in the temperature standard: 1) Absolute numeric criterion of 64 degrees F with a provision for the development of a basin temperature management plan for anthropogenic sources when the temperature exceeds this level; 2) Absolute numeric criterion of 55 degrees F for salmonid spawning, egg incubation and fry emergence. Both of these criteria would be measured as the average of the daily maximum temperatures over a seven day moving period.

Stream temperature monitoring data indicates that for some tributaries and the mainstem of the North Fork, water temperatures frequently are above the current state standards of 58 degrees F during some portions of the critical summer season. Stream temperatures tend to reach a maximum during the month of August when the solar angle is relatively high, air temperatures are high, streamflows are low, and days are long.

Although water temperatures tend to reach maximum values during the month of August, stream temperatures during the Months of June and July may also exceed 58 degrees F. Table 8 of this chapter displays the average maximum water temperatures in the North Fork near Westfir during the months of June, July, and August. For the period of record from 1980 through 1993, in the months from June through August, analysis of monitoring data indicates the seven day moving average of stream temperatures was greater than or equal to 64 and 55 degrees F for 39 and 88 percent of this time period respectively.

Table 8: Average Maximum Daily Water Temperatures for June, July, & August for North Fork Middle Fork Willamette River Near Westfir (in Degrees Fahrenheit)

Year	June	July	August
1980	54	67	66
1981	56	61	-
1982	56	63	65
1983	55	58	64
1984	50	62	66
1985	58	66	65
1986	61	64	69
1987	62	63	65
1988	56	67	65
1989	55	61	62
1990	55	65	65
1991	58	66	67
1992	68	67	67
1993	56	58	64

Although little stream temperature data is available on the main stem of the North Fork above the lower 1.5 miles, temperature measurements were taken in conjunction with a Level II stream survey of the North Fork from August 26 through September 12 of 1991 from the confluence with the Middle Fork to Kiahanie Campground (river mile 22). Temperatures measured during the survey ranged from 48 to 64 degrees F. A Level II stream survey from Kiahanie Campground to Skookum Creek (river mile 36.5) completed from July 25 to August 7, 1990, indicates water temperatures averaged 54 degrees F with a measured high temperature of 55 degrees.

Figure 6 of this chapter displays the average maximum values of stream and air temperature for the month of August from 1980 through 1993 for the North Fork near Westfir. Figure 7 of this chapter displays the average maximum stream temperature and mean discharge for August for the same location.

Figure 6: Average Maximum Stream Temperature and Average Maximum Air Temperature for August

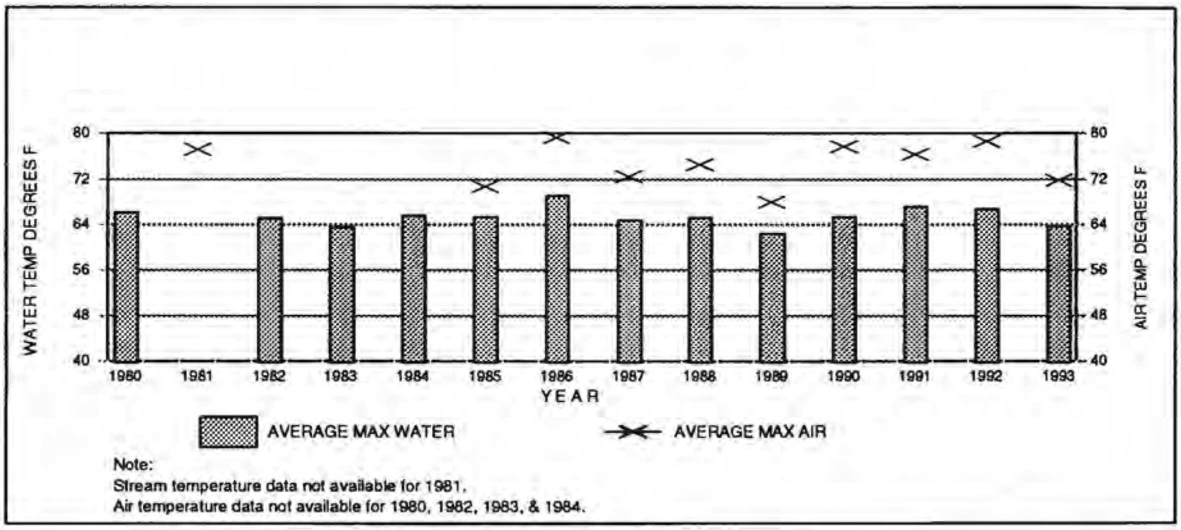
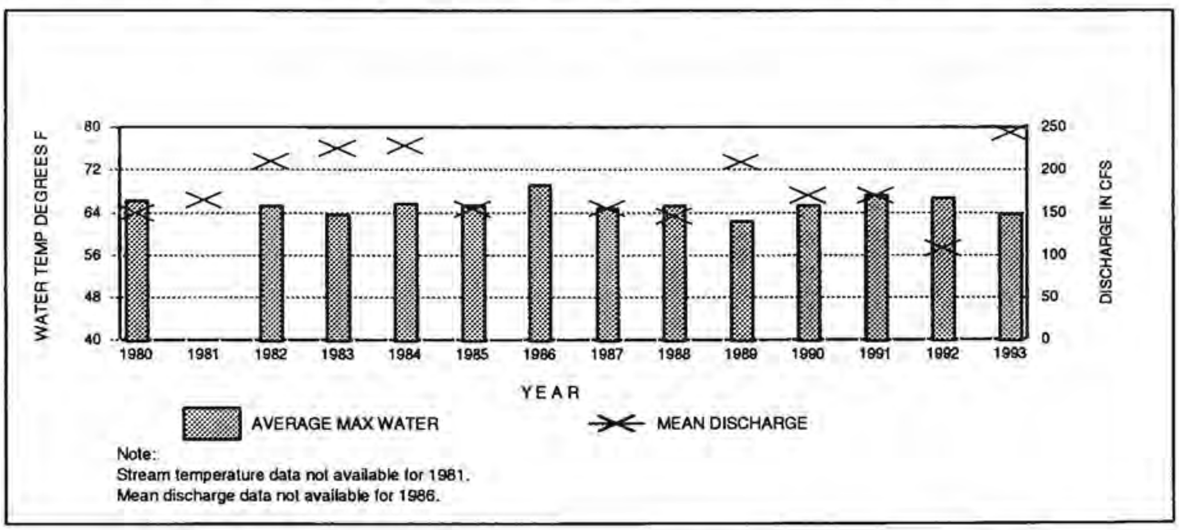


Figure 7: Average Maximum Temperature and Average Minimum Discharge North Fork Near Westfir



Although high stream temperatures are generally associated with low flow summer periods, analysis of this data indicates a greater correlation of average maximum stream temperatures and average maximum air temperatures (r squared value of 0.72) when compared to average maximum stream temperature and mean monthly flow (r squared value of 0.39).

Table 9 displays a summary of temperature monitoring data for streams tributary to the North Fork.

Table 9: Stream Temperatures During August (tributary streams near confluence with the North Fork)

Stream Name	Year	Maximum Water Temp. (Deg F)	Average Maximum Temp. (Deg F)	Percent of days Temp. > 58 Deg F
Huckleberry	1994	64	57	26
"	1993	59	56	22
"	1992	61	58	52
"	1991	61	58	55
Christy	1994	66	63	100
"	1993	56	51	0
"	1992	64	59	65
"	1991	68	64	100
Lowell	1994	62	59	58
"	1993	61	56	32
"	1992	64	60	71
"	1991	63	60	84
Devils Canyon	1994	56	55	0
"	1993	56	54	0
"	1992	60	57	39
"	1991	60	57	23
Cayuse	1994	56	54	0
"	1993	56	53	0
"	1992	59	56	26
"	1991	74	64	61

STREAM TURBIDITY

Reference Conditions

Prior to management activity the North Fork elevated turbidity would have been associated with high runoff events. No data exits with which to determine the absolute values of these natural turbidity levels. During low flow periods the river was likely very clear, with elevated turbidity evident possibly only after extensive fire had destabilized slopes, an event thought not to have been particularly common.

Current Conditions

Turbidity is typically due to suspended particles of silt and clay in the water column although fine organic matter and micoorganisms may also affect turbidity values. Increased values of turbidity may affect the recreational and aesthetic uses of water as well as the difficulty of effective treatment for domestic use. Studies indicate the ability of salmonids to find and capture food may be impaired at turbidity values in the range of 25-70 NTUs, growth reduced and gill tissues damaged after 5-10 days of exposure to turbidity of 25 NTUs, and some species may be displaced at 50 NTUs (MacDonald et al. 1991).

Oregon administrative rules state: No more than a 10 percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity (OAR Chapter 340, Division 41 - Department of Environmental Quality). Within the North Fork Watershed, the majority of sediment sources contributing to increased levels of turbidity originate from nonpoint sources. Separating management related turbidity from natural levels would require an in depth level of data collection and analysis. This data is not available at this time.

Elevated turbidity values for the North Fork are generally associated with high runoff events from October through May, and with localized high intensity rainfall events during the summer usually associated with thunder storms. Shallow rapid mass movements in the form of debris torrents can result in dramatic short-term changes in turbidity. Chronic sources of fine sediment contributing to increases in turbidity include road and hill slope surface erosion, and stream bank cutting where banks are composed of unconsolidated material and vegetation has been disturbed.

The degree to which specific drainage's contribute chronic sources of sediment varies by management history combined with soil type and geologic structure. See Physical - Geology section, this chapter for a related discussion. Field observations have noted the Chalk Creek drainage as being a source area of turbidity for the lower North Fork. This area contains unstable landtypes typically associated with soils of high clay content and can be chronic sediment sources. The majority of suspended sediment currently entering the main stem of the North Fork from Chalk Creek is thought to be associated with the effects of a large debris torrent which occurred in 1986 and directly impacted more than 3 miles of stream channels within the Chalk Creek drainage. Field observations indicate this sediment source currently has a significant impact on turbidity in the North Fork below its confluence with Chalk Creek during periods of high runoff.

Stream survey data also indicates a high number of mass wasting sites adjacent to stream channels in planning subdrainages 17D (High Creek), 17E (Hamner Creek), 17F (McKinley Creek), and 17G (Chalk Creek). These sites are likely to be source areas of sediment for these stream channels.

Monitoring data collected during water years 1992 through 1994 near the mouth of the North Fork indicated turbidity values generally range from less than one NTU to greater than 40 NTUs during high runoff events (recurrence interval from one to three years). Turbidity values tend to increase rapidly as stream flows increase and turbidity declines quickly as flows subside. The highest turbidity values are associated with high runoff events in November and December. Monitoring data indicates high variability for similar magnitudes of flow.

CHANNEL CONDITION

Reference Conditions

See the above section on large woody material. Channel conditions in general are very much influenced by the presence and distribution of large wood. Overall channel conditions prior to management probably varied substantially by stream type and due to the influence of varying amounts of LWM. Most stream reaches likely had relatively high amounts of LWM before management impacts occurred. Historic stream survey data indicates naturally occurring high amounts of LWM. Streams located in areas of high fire frequency and little management influence (eg. Fisher Creek) indicates a natural condition of low amounts of LWM.

Current Conditions

North Fork channel conditions were analyzed by subwatershed except for the main stem of the North Fork and Christy Creek which were analyzed separately because they flow through more than one subwatershed. Physical and biological characteristics of each subwatershed as well as the main stem North Fork and Christy Creek were determined from stream survey data. Many of these characteristics can be compared to objective values to aid in determining the current condition of the watershed (table 10 of this chapter). A total of 145.2 miles of streams have been surveyed in the North Fork Watershed.

Table 10: Objectives for Aquatic Habitat Variables

Habitat Variable	Definition Or Range	Objective	Source
Large Pools	< 2% gradient	one pool / 5-7 channel widths	Willamette N.F. Plan
Large Pools	2 - 8% gradient	one pool / 3-5 channel widths	Willamette N.F. Plan
Large Pools	Channel width	See below (*)	PACFISH
Large Wood	Undefined	80 pieces over 24" dbh & 50' length per mile	PACFISH
Large Wood	Low gradient streams	105 pieces longer than stream width with pieces > 25" per mile	Willamette N.F. Plan (Appendix)
Large Wood	High gradient streams	50% of channel length should be influenced	Willamette N.F. Plan (Appendix)
Width:Depth Ratio	All streams	< 10	PACFISH
Temperature	Streams (salmonids)	Meet state standards (58 degrees F)	State Standards

(*) PACFISH Objective for Pools per Mile by Wetted Stream Width (in feet)

Wetted Stream Width	10	15	20	25	50	75	100	125	150	175	200
Pools / Mile	96	70	56	47	26	23	18	14	12	10	9

Assessing channel condition and predicting channel response requires identification of functionally similar portions of the channel network. On the Willamette National Forest, the identification of Valley Segment Types has been incorporated into the stream survey methodology to stratify stream segments based on similar drainage morphology. Table 11 of this chapter outlines the valley segment types delineated within the North Fork Watershed.

Relatively high gradient streams associated with Steeply Incised Valley/Steep and Moderate Channel Gradients (types 2 and 3) are generally high debris transport streams with channel features including frequent vertical drop scour pools and infrequent log jams. Lower gradient streams associated with valley segment types such as U-Shaped Glacial Trough (type 7) will have depositional features such as point bars and would be expected to have abundant log jams. Channel stability ratings are an indication of sediment source areas often from stream bank and stream bed erosion. Areas indicated as having a poor stability rating may be particularly susceptible to adverse impacts during high flow events. It should be noted that valley\headwall tributaries are probably under represented since many of these are Class IV streams which are not surveyed under current stream survey methodology. What follows is a synopsis of the stream surveys conducted in the North Fork Watershed.

MAIN STEM OF THE NORTH FORK OF THE MIDDLE FORK OF THE WILLAMETTE

VALLEY SEGMENT TYPES

The main stem of the North Fork is composed of several different valley segment types (table 12 of this chapter). The lower North Fork flows through sections of lower alluvial valleys, alluviated mountain valleys, and steeply incised valleys with moderate channel gradients. Valley segment types for the middle reaches of the North Fork include moderate slope bound valleys, and alluviated mountain

Table 11: Valley Segment Types in the North Fork Watershed

Valley Segment Type	Stream Order	Sideslope	Channel Pattern	Land Form Features	Channel Type	Channel Gradient	Large Woody Material
Lower Alluvial Valley (1)	Any	0-10%	unconstrained, highly sinuous	on lower large river floodplain/ lacustrine terrace, elevated glacial valleys	alluvial	0-5%	abundant large jams on channel margins
Alluvial Fan (2)	2-4	flat-moderate	sinuous, generally unconstrained	occurs where tributaries enter low gradient streams	alluvial	1-6%	frequent large jams and individual pieces
Steeply Incised Valley Moderate Channel Gradient (3)	2-4	steep	constrained, slightly sinuous	downcutting steep hillsides, often vertical canyon walls	bedrock, alluvial in short reaches	3-6%	infrequent large jams
Steeply Incised Valley /Steep Channel Gradient (4)	2-4	steep, often vertical	constrained, slightly sinuous	downcutting steep hillsides, often vertical canyon walls	bedrock, big boulder	>6%	infrequent large jams
Incised Glacial Till/Incised Colluvium Deposits (5)	2-4	steep w\ flat to steep upper slopes	straight-slightly sinuous	downcutting through glacial deposits or colluvium substrate - high potential bank failure	boulder / rubble	2-5%	abundant single pieces and occasional jams
Moderate-Slope Bound Valley (6)	1-3	flat - moderate	straight-slightly sinuous	lower foothill sand minor fault block areas as well as upper drainage areas	alluvial, short sections of bedrock	1-5%	small debris jams & single stems common
U-Shaped Glacial Trough (7)	1-3	flat	moderate-high meanders	located in bottoms and lower side slopes of U-shaped glacial valleys	alluvial	0-3%	abundant small jams and single pieces
Valleywall/Headwall Tributary (8)	1-2	moderate-steep	straight; stairstep profile	small tributaries flowing over moderate/steep hillsides	bedrock or boulder	1-5 %	variable, creates stairsteps
Lava Flow/Spring Fed Meadow (9)	1-2	0-10%	slight meander	low gradient slopes and slight downcutting	alluvial or boulders	0-3%	infrequent large jams, beaver important
Alluviated Mountain Valley (10)	2-4	flat w\ steep upper slopes	high meanders and braiding	wide annual floodplain, continual alluvial deposits	alluvial	0-3%	frequent jams and single pieces create pools
Moderately Incised Valley (11)	2-3	steep w\ flat upper slope	straight - slightly sinuous	steep, bedrock banks with broad flat upslope areas	bedrock, boulder and rubble	3-5%	infrequent channel width jams, few single pieces

valleys. The upper reaches flow through U-shaped glacial troughs, steeply incised valleys with steep channel gradients, as well as moderate slope bound valleys.

Table 12: Valley Segment Types for the Main Stem North Fork

Reach Number	Reach Length (miles)	Cumulative Miles	Valley Segment Type	Reference Point for Start of Reach
1	4.1	4.1	Lower Alluvial Valley (1) \ Alluviated Mountain Valley (10)	Confluence with Middle Fork
2	2.3	6.4	Steeply Incised Valley \ Moderate Channel Gradient (3)	at Dartmouth Creek
3	2.2	8.6	Alluviated Mountain Valley (10)	at Huckleberry Creek
4	2.0	10.6	Steeply Incised Valley \ Moderate Channel Gradient (3)	at Ninth Creek
5	2.0	12.6	Steeply Incised Valley \ Moderate Channel Gradient (3)	at McKinley Creek
6	0.9	13.5	Steeply Incised Valley \ Moderate Channel Gradient (3)	at Christy Creek
7	2.0	15.5	Moderate Slope Bound Valley (6)	
8	2.5	18.0	Alluviate Mountain Valley (10)	
9	2.7	20.7	Alluviate Mountain Valley (10)	at Devils Canyon Creek
10	2.1	22.8	Alluviate Mountain Valley (10)	at Kiahanie Campground
11	4.6	27.4	Alluviate Mountain Valley (10)	at Brock Creek
12	7.7	35.1	U -- Shaped Glacial Trough (7)	
13	10.5	45.6	U -- Shaped Glacial Trough (7)	at Moolack creek
14	0.8	46.4	U -- Shaped Glacial Trough (7)	at Skookum Creek
15	2.3	48.7	Steeply Incised Valley \ Steep Channel Gradient (4)	at small creek from Otter Lake outlet
16	4.2	52.9	Moderate Slope Bound Valley (6)	at small creek from Eastern Brook Lake

LARGE WOODY MATERIAL

Given the valley segment types present in the main stem of the North Fork, large woody material would be expected to be present in the form of frequent jams and single pieces in the alluvial reaches, such as the alluviated mountain valleys and u-shaped glacial troughs. Steeper gradient reaches, such as those flowing through steeply incised valleys, would be expected to have less frequent, large debris jams. Figure 8 of this chapter shows the current levels of large woody material along the longitudinal profile of the main stem North Fork. All reaches of the main stem North Fork, including those in which large wood would be expected to be abundant, are below large woody material objective values (figure 9 of this chapter). Large wood is most abundant in the upper reaches of the North Fork although current levels of wood are lower than objective and historic values. Notes from a 1938 stream survey (McIntosh et al., 1992) reported that the area from Brock Creek to Fisher Creek (reach 10) had so many pieces of large wood that it was difficult to see the river. This quantity of in-stream large woody material led to the formation of a braided channel. In this same section of stream during a 1991 survey, there were only 47 pieces of large wood per mile. In addition, there is currently very little braiding in this same section of the North Fork.

Figure 8: Longitudinal Profile for the North Fork

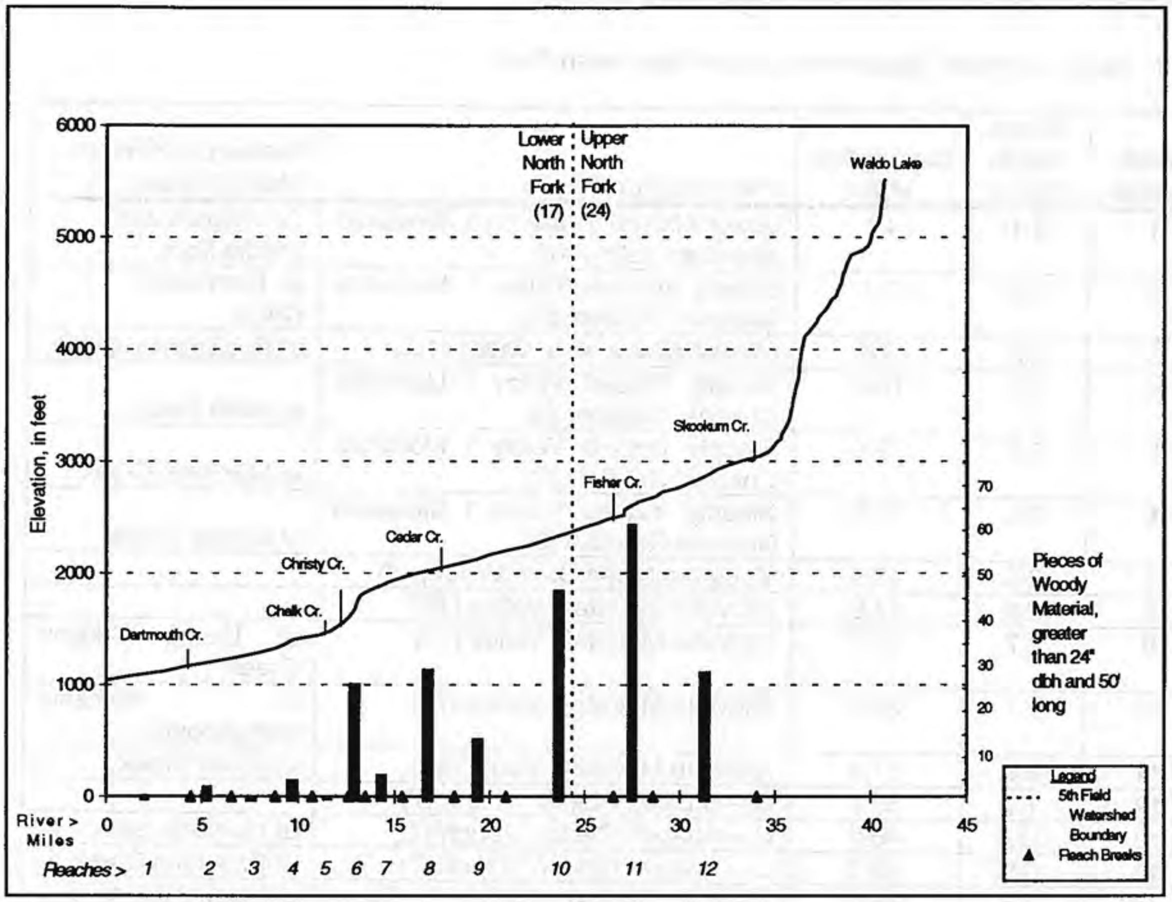
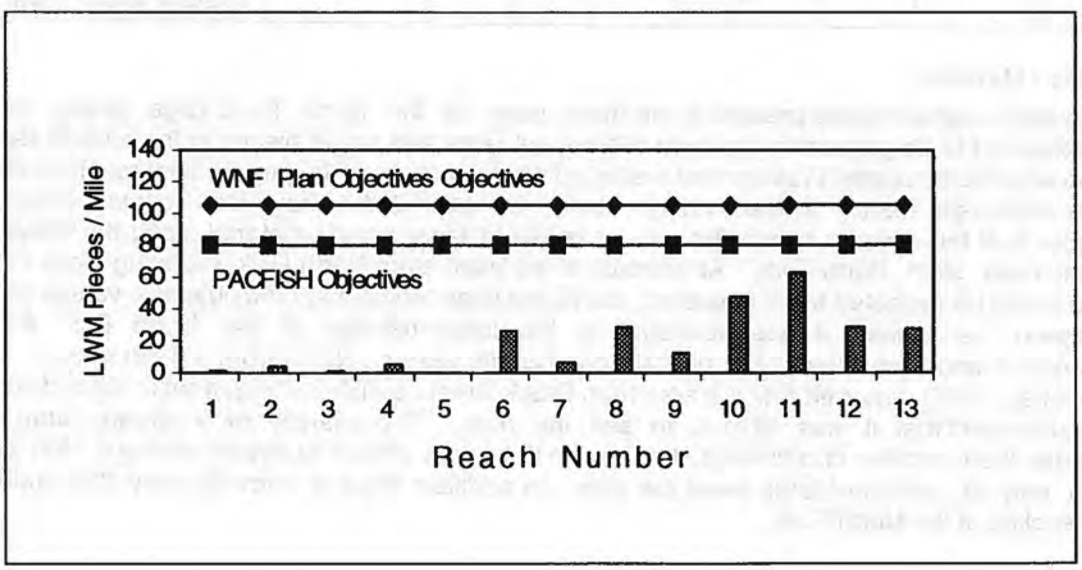


Figure 9: Instream Large Woody Material (LWM) for Main Stem North Fork



LARGE POOLS

The reduced amount of large woody material may contribute to the low numbers of large pools currently present in the main stem North Fork. In alluvial reaches wood is a major component in the formation of large pools. In higher gradient, boulder dominated reaches, pools are typically associated with large log jams or occur as pocket pools associated with large boulders. The number of large pools/mile is well below the objective values in all reaches surveyed (Appendix G). Comparisons of the large pools/mile from the 1991 stream survey with the survey completed in 1938 (McIntosh et al., 1992) shows that there are currently about half as many large pools in the main stem of the North Fork as there were historically (Table 13 of this chapter).

Table 13: Pools Per Mile for the Main Stem North Fork (from 1938 and 1991 stream survey's)

	1938 Survey		1991 Survey	
Location (Total Miles)	# Of Pools Per Mile	Percent Difference	# Of Pools Per Mile	Location (Total Miles)
Middle Fork -- Cain Cabin Trail (8.3)	11.9	60.5 %	4.7	Reaches 1-3 (8.6)
Cain Cabin Trail -- Christy Creek (6.0)	11.7	54.7 %	5.3	Reaches 4-5 (4.0)
Christy Creek -- Devil's Canyon Creek (6.5)	10.9	51.4 %	5.3	Reaches 6-8 (5.4)
Devil's Canyon -- Brock Camp HWY Bridge (4.6)	16.5	59.9 %	6.7	Reaches 9-10 (4.1)
Brock Camp HWY Bridge -- Fisher Creek (4.7)	11.7	17.9 %	9.6	Reach 11 (9.6)
Fisher Creek -- Skookum Creek (7.2)	6.8	39.7 %	4.1	Reaches 12-13 (7.0)

MAIN STEM OF CHRISTY CREEK

VALLEY SEGMENT TYPES

Valley segment types for the main stem of Christy Creek include steeply incised valleys with moderate and steep channel gradients in the lower reaches (1-3) and moderate slope bound valleys in the upper reaches (4-5). (Table 14 of this chapter).

Table 14: Valley Segment Types for Christy Creek

Reach Number	Reach Length (miles)	Cumulative Miles	Valley Segment Type
1	2.3	2.3	Steeply Incised \ Moderate Channel Gradient (3)
2	2.4	4.7	Steeply Incised \ Steep Channel Gradient (4)
3	2.3	7.0	Steeply Incised \ Moderate Channel Gradient (3)
4	1.7	8.7	Moderate Slope Bound Valley (6)
5	2.1	10.8	Moderate Slope Bound Valley (6)

LARGE WOODY MATERIAL

Given the valley segment types of the main stem of Christy Creek, infrequent large jams would be expected in the lower reaches and small debris jams and single pieces would be expected to be numerous in the upper reaches. Figure 10 of this chapter shows the amounts of large wood per mile along the longitudinal profile of Christy Creek. The main stem of Christy Creek is below Willamette N.F. Plan objective levels for large woody material for its entire length (Figure 11 of this chapter).

The lower 2.3 miles (reach 1) and the upper 2.1 miles (reach 5) were farthest from objective values for large woody material within the main stem of Christy Creek. Reach 3 (located 4.7 miles from the mouth) had the most large woody material.

Figure 10: Longitudinal Profile for Christy Creek

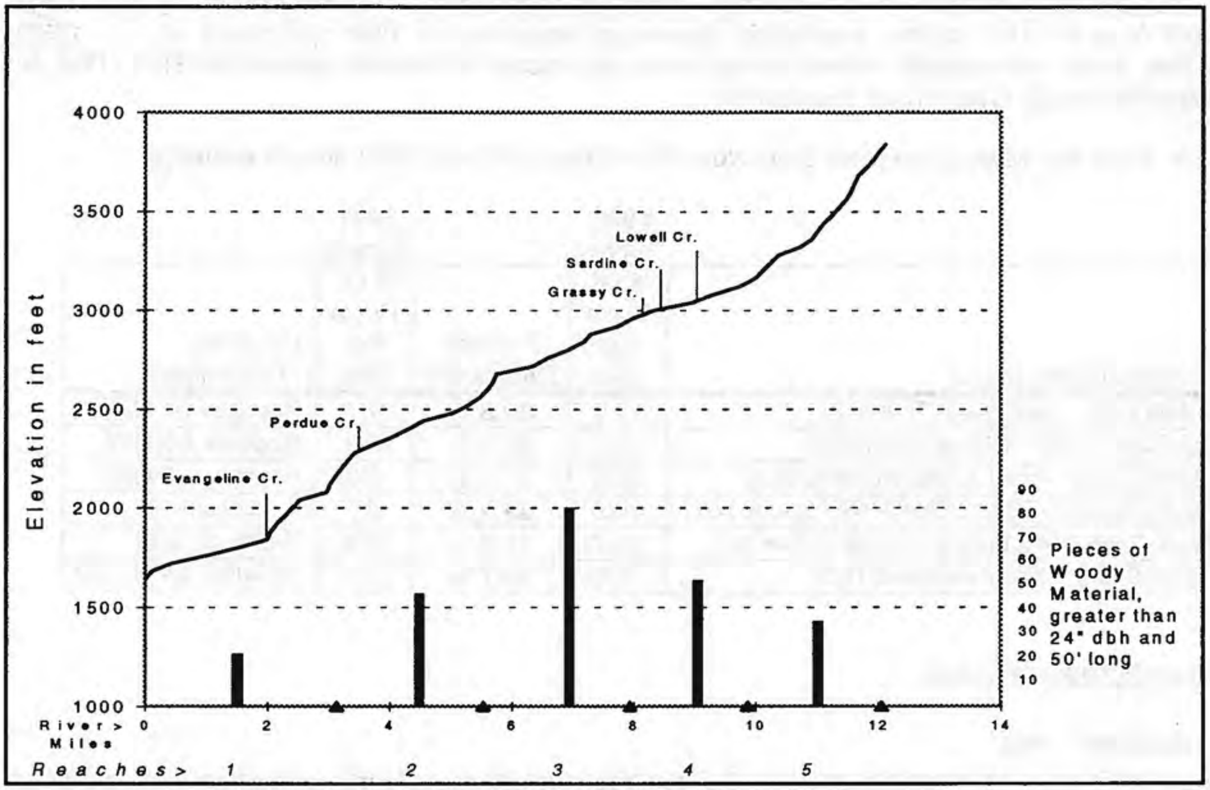
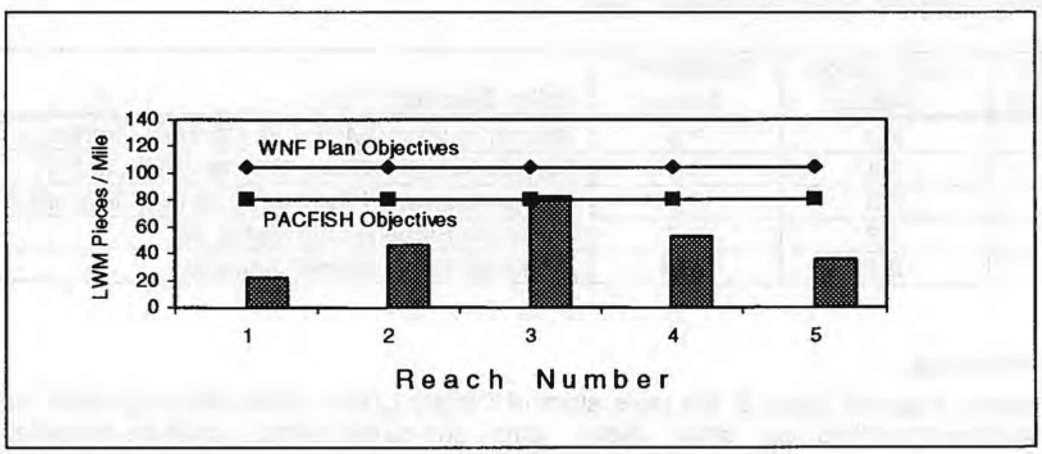


Figure 11: Instream Large Woody Material (LWM) for Main Stem Christy Creek



LARGE POOLS

Large woody material plays a major role in large pool formation in the upper reaches while boulders are important in the lower, higher gradient reaches. The number of large pools per mile also fall below the minimum objective values. The number of large pools per mile in the main stem of Christy Creek declined about 25 percent between 1938 (13.5 pools/mile for the first two miles from McIntosh et al.) and 1991 (10.0 pools/mile for the first 2.3 miles of Christy Creek from USFS stream surveys, 1991).

WESTFIR SUBWATERSHED (171)

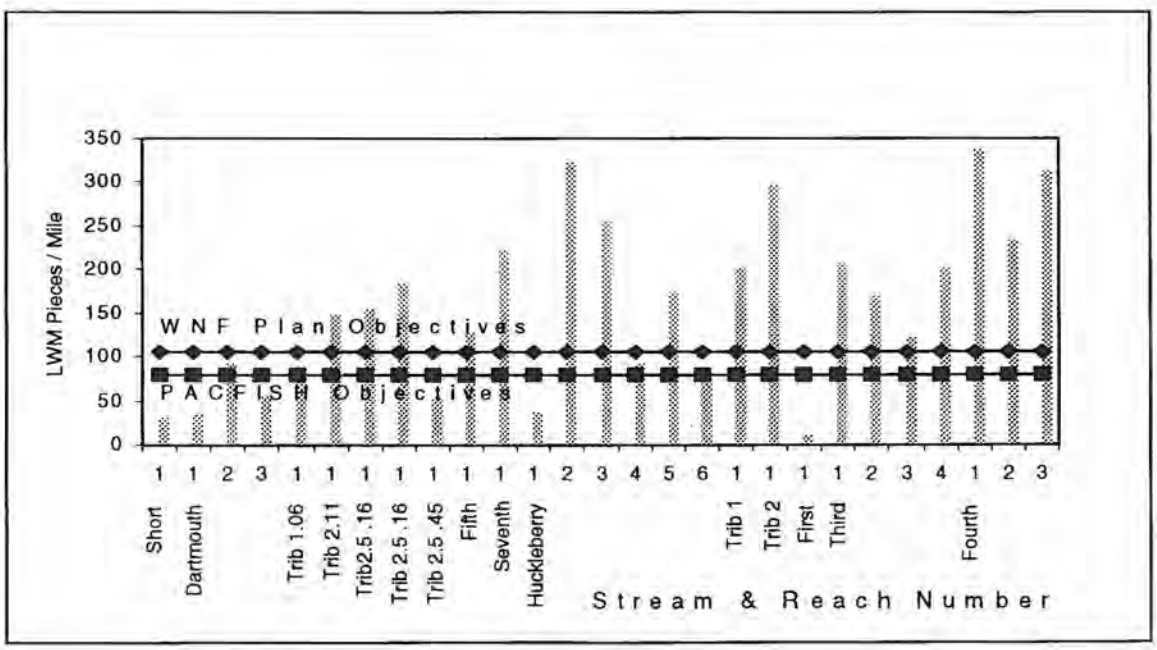
VALLEY SEGMENT TYPES

Streams that were surveyed in this subwatershed include Short, Dartmouth, Huckleberry, First, Third, Fourth, Fifth, and Seventh. Table 15 of this chapter shows the miles of stream by valley segment type for the Huckleberry/Dartmouth Creek Subwatershed. The majority of streams in this subwatershed flow through moderate slope bound valleys and steeply incised valleys with moderate channel gradients. Other valley segment types within this watershed include incised glacial till and valleywall\headwall tributaries as well as alluvial fans.

Table 15: Valley Segment Types for the Westfir Subwatershed (171)

Valley Segment Type	Miles	%
Alluvial Fan (2)	0.7	5.0
Steeply Incised/ Moderate Gradient (3)	4.5	31.9
Incised Glacial Till/Colluvium Deposits (5)	1.1	7.8
Moderate Slope Bound Valley (6)	5.6	39.7
Valleywall/Headwall Tributary (8)	2.2	15.6

Figure 12: Instream Large Woody Material (LWM) for Huckleberry / Dartmouth Subwatershed (171)



LARGE WOODY MATERIAL

Given the dominant valley segment types in this subwatershed large amounts of woody material would be expected to be present in the form of small debris jams and single pieces in the alluvial reaches with a few large jams in the higher gradient reaches. There were 122 debris jams of various sizes. Stream surveys indicate that 50.7% of the streams surveyed in this subwatershed did not meet objective values outlined in the Appendix of the Willamette National Forest Plan (Figure 12 of this chapter).

LARGE POOLS

Dominant substrate types in this subwatershed include cobble, rubble, small boulders, and gravel. In reaches dominated by boulders, pocket pools would be expected to make up the majority of pool habitat while in alluvial reaches composed primarily of cobbles and gravel's, wood becomes an important component in the formation of channel spanning pools. Large pool habitat is currently lacking in the entire subwatershed. The only area reaching objective values for large pools was the first 0.2 miles of Huckleberry Creek. All other streams were far below objective values. The lack of large wood, especially in the alluvial reaches of this subwatershed, may explain the low numbers of large pools.

CHANNEL STABILITY

Channel stability was rated as good for the majority of the subwatershed. There were 13 documented sites of mass wasting with the majority occurring in Dartmouth (10 sites) and Short Creek (3 sites).

DEVILS CANYON CREEK SUBWATERSHED (172)

VALLEY SEGMENT TYPES

Streams surveyed in this subwatershed include Devil's Canyon, Cedar, and Hemlock Creeks as well as several small tributaries to the North Fork. Table 16 of this chapter shows the miles of stream by valley segment type for the Devil's Canyon Subwatershed. This subwatershed is composed of four valley segment types : alluvial fan, steeply incised moderate channel gradient, steeply incised steep channel gradient, and valley wall/headwall tributaries.

Table 16: Valley Segment Types for the Devil's Canyon Creek Subwatershed (172)

Valley Segment Type	Miles	%
Alluvial Fan (2)	1.8	19.8
Steeply Incised/ Moderate Gradient (3)	1.8	19.8
Steeply Incised/Steep Gradient (4)	3.0	32.9
Valleywall/Headwall Tributary (8)	2.45	26.9

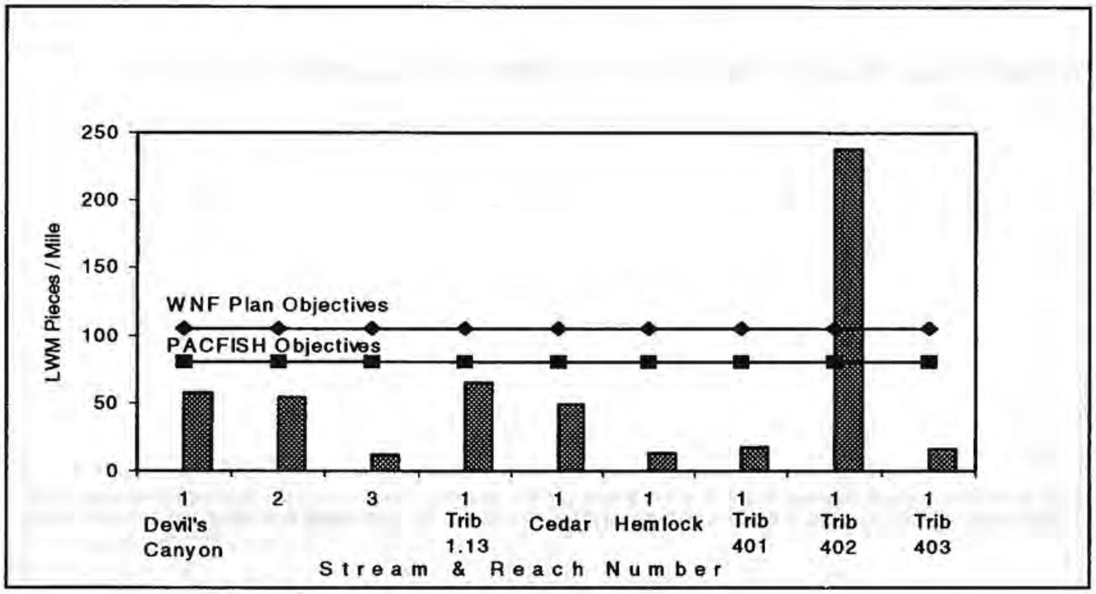
LARGE WOODY MATERIAL

Given the dominant valley segment types in this watershed, infrequent large jams and more frequent small jams as well as individual pieces of wood would be expected in this subwatershed. There were only 11 debris jams in this subwatershed. In addition, 93.6% of the streams surveyed fell below WNF Plan minimum objective values for large woody material (Figure 13 of this chapter). Only one stream in this subwatershed, a small tributary, had greater than 105 large pieces of wood per mile.

LARGE POOLS

Dominant substrates in this subwatershed include cobble, small boulders, gravel, and bedrock. In reaches dominated by small boulders the most prevalent pools would be expected to occur as pocket pools. In the alluvial reaches large woody material would be expected to be a component in large pool formation. Large pool habitat in this subwatershed is currently lacking. All streams within this subwatershed are below the recommended objective values for the number of pools per mile. The lack of large wood may explain the low numbers of large pools, especially in alluvial reaches of the subwatershed.

Figure 13: Instream Large Woody Material (LWM) for Devil's Canyon / Cedar Subwatershed (172)



CHANNEL STABILITY

There are 24 documented sites of mass wasting in this subwatershed. Mass wasting is evident in reaches 1 and 2 of Devil's Canyon Creek as well as its tributaries. Mass wasting occurred frequently in reach 1 of Cedar creek (there were 12 sites with an average size of 15 X 50). Reach 2 of Cedar Creek and Hemlock Creek also have signs of mass wasting.

UPPER CHRISTY CREEK SUBWATERSHED (173)

VALLEY SEGMENT TYPES

Streams located in this subwatershed include Grassy, Mossy, Lowell and Sardine. Table 17 of this chapter shows the miles of stream by valley segment type for the Upper Christy Creek Subwatershed. Dominant valley segment types in this subwatershed include moderate slope bound valley and valleywall\headwall tributaries although there are also stream sections that flow through an alluviated mountain valley and incised glacial till.

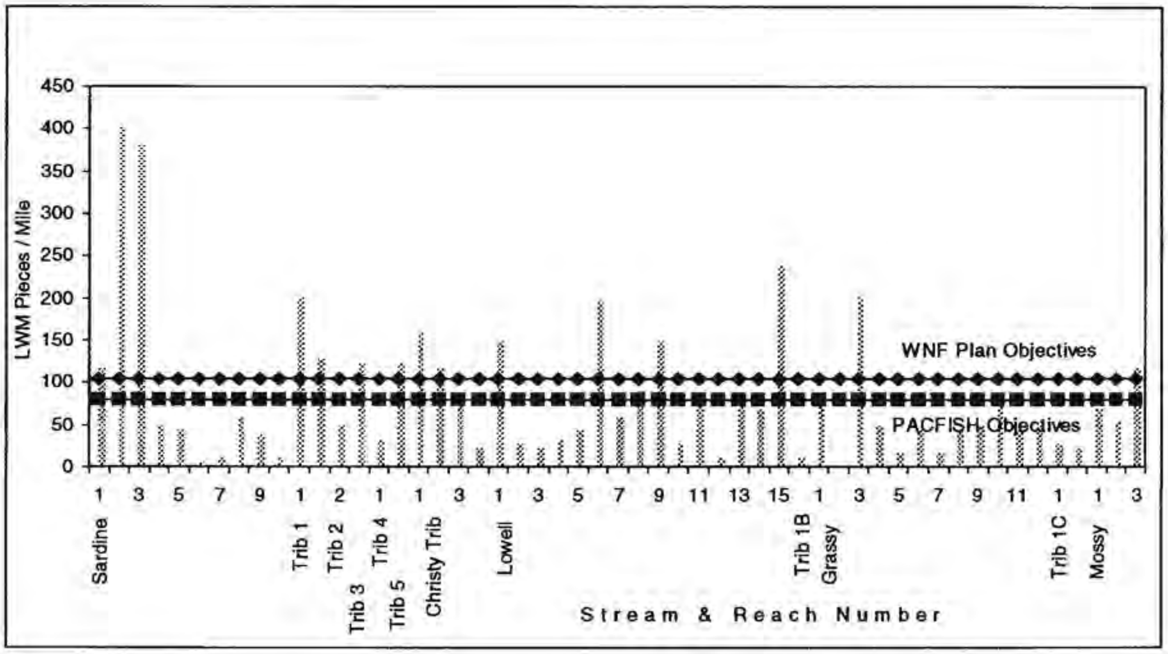
Table 17: Valley Segment Types for the Upper Christy Creek Subwatershed (173)

Valley Segment Type	Miles	%
Incised Glacial Till/Colluvium Deposits (5)	0.2	1.0
Moderate Slope Bound Valley (6)	12.34	60.5
Valleywall/Headwall Tributary (8)	5.96	29.2
Alluviated Mountain Valley (10)	1.9	9.3

LARGE WOODY MATERIAL

Given the dominant valley segment types in this subwatershed frequent small debris jams and single pieces of wood would be expected in low gradient reaches. There were 146 debris jams in this subwatershed, but overall large woody material was lacking. 76% of the streams surveyed in this subwatershed did not meet WNF Plan minimum objective values for large woody material (Figure 14 of this chapter). Large woody material is abundant in some parts of the watershed and is rare in other parts.

Figure 14: Instream Large Woody Material (LWM) for Upper Christy Subwatershed (173)



LARGE POOLS

Dominant substrates in this subwatershed include rubble and boulder in some reaches which would tend to lead to the formation of pocket pools and cobble and gravel in others where large wood would be expected to be an important factor in large pool formation. Large pool habitat is lacking in all of the streams located in this subwatershed except for reach 6 of Lowell Creek which met both PACFISH and WNF Plan objective minimum values. The dominant substrate of this reach was cobble and this reach contained a large amount of large woody material. The lack of large wood in the majority of the alluvial reaches of this subwatershed may explain the low numbers of large pools.

CHANNEL STABILITY

Channel stability for this watershed was rated as good. There were five documented sites of mass wasting in the upper portions of Lowell Creek (reaches 10 and 11), and the middle reaches of Grassy Creek (reaches 6 and 7).

LOWER CHRISTY CREEK SUBWATERSHED (174)

VALLEY SEGMENT TYPES

Streams surveyed in this subwatershed include Billy, Evangiline, Perdue, Nehi and miscellaneous tributaries. Table 18 of this chapter shows the miles of stream by valley segment type for the Lower

Christy Creek Watershed. Dominant valley segment types in this watershed include alluviated mountain valley, steeply incised valley with a steep channel gradient and valleywall\headwall tributaries. Moderate slope bound valleys, incised glacial till\colluvium deposits, and steeply incised moderate channel gradient valley segment types were also present.

Table 18: Valley Segment Types for the Lower Christy Creek Subwatershed (174)

Valley Segment Type	Miles	%
Steeply Incised/ Moderate Gradient (3)	0.3	3.3
Steeply Incised/Steep Gradient (4)	1.8	19.8
Incised Glacial Till/Colluvium Deposits (5)	0.3	3.3
Moderate Slope Bound Valley (6)	0.8	8.8
Valleywall/Headwall Tributary (8)	2.7	29.7
Alluviated Mountain Valley (10)	3.2	35.2

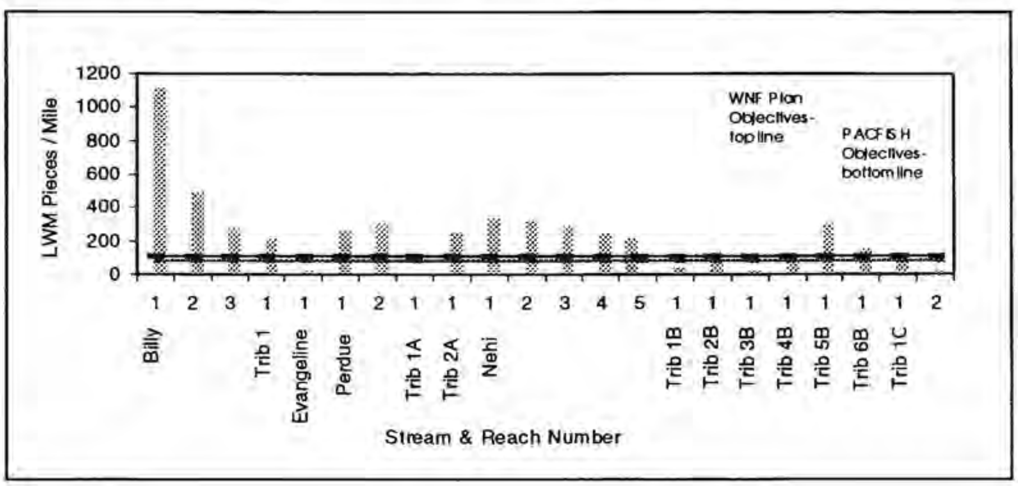
LARGE WOODY MATERIAL

Given dominant valley segment types in this subwatershed, large woody material would be expected to be abundant, occurring in large and small jams as well as single pieces (especially in alluviated mountain valley reaches). Large woody material is abundant in this subwatershed (Figure 15 of this chapter). There were 146 debris jams in this subwatershed and only 16.2% of the streams surveyed did not meet the large woody material objectives outlined in the WNF Plan. Nearly all of the streams meet minimum objectives for the pieces of large woody material per mile. Billy Creek and its tributary have more wood than any other stream in the North Fork Watershed. Nehi and Perdue Creeks and the majority of their tributaries also meet the suggested minimum standards. The only creek not meeting minimum values of large woody material in this subwatershed is Evangiline Creek.

LARGE POOLS

Although there are large amounts of wood in this subwatershed, the number of large pools per mile is generally lower than the minimum objective values. This may be due to the dominant substrates in this subwatershed. Substrates such as boulders and rubble, which are contained throughout this subwatershed, typically lead to the formation of pocket pools rather than channel spanning pools. There are only a few alluvial reaches where large woody material would be expected to be an important component of large pool formation.

Figure 15: Instream Large Woody Material (LWM) for Lower Christy Creek Subwatershed (174)



CHANNEL STABILITY

Channel stability for this subwatershed was rated as good. There is no documentation of mass wasting along stream banks.

NORTH FORK WILLAMETTE RIVER SUBWATERSHED (175)

VALLEY SEGMENT TYPES

Streams surveyed in this subwatershed include High, Hammer, McKinley, and Chalk. Table 19 of this chapter shows the miles of stream by valley segment type for this subwatershed. The dominant valley segment type is steeply incised valley with a moderate channel gradient although there are also stream segments that flow through alluvial fans, incised glacial till, steeply incised valley with a steep channel gradient, and valley wall/headwall tributaries.

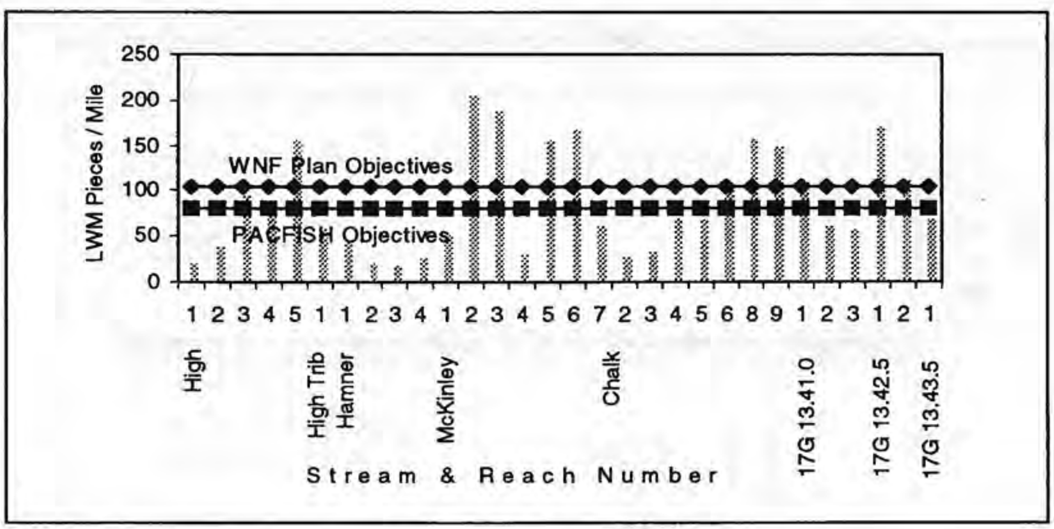
Table 19: Valley Segment Types for the North Fork Middle Fork Willamette Subwatershed (175)

Valley Segment Type	Miles	%
Alluvial Fan (2)	2.3	10.6
Steeply Incised/ Moderate Gradient (3)	14.5	66.8
Steeply Incised/Steep Gradient (4)	.4	1.8
Incised Glacial Till/Colluvium Deposits (5)	3.1	14.3
Moderate Slope Bound Valley (6)	.9	4.1
Valleywall/Headwall Tributary (8)	.5	2.3

LARGE WOODY MATERIAL

In stream reaches flowing through steeply incised moderate channel gradient valley segment types infrequent large jams would be expected with single pieces moving out during flood events. In lower gradient reaches more individual pieces of large woody material would be expected. Much of the large wood in this subwatershed is located in debris jams (158). 68.8% of the streams surveyed did not meet WNF Plan minimum objective for large woody material (Figure 16 of this chapter). Large woody material is abundant in some portions of this watershed and sparse in others.

Figure 16: Instream Large Woody Material (LWM) for Chalk / McKinley Subwatershed (175)



LARGE POOLS

Streams in this subwatershed are currently lacking in pool habitat when compared to minimum objective values. Dominant substrates in this subwatershed include cobble, gravel, and small boulders. Large woody material would be expected to be an important component of pool formation especially in gravel cobble areas. The lack of large wood in this subwatershed may explain the low numbers of large pools.

CHANNEL STABILITY

Channel stability in this subwatershed was rated as fair. There is evidence of mass wasting adjacent to stream channels in nearly every reach of every stream in the subwatershed. The only area that does not show much evidence of mass wasting are the lower reaches of McKinley Creek. High, Hammer, and Chalk all show signs of mass wasting. The areas of instability identified in these stream surveys were apparently not large enough to be included in the high-elevation aerial photo reconnaissance of landslides mentioned in the Geology section of this Chapter. The most unstable areas are the tributaries to Chalk Creek.

FISHER CREEK SUBWATERSHED (241)

VALLEY SEGMENT TYPES

Streams that were surveyed in this subwatershed include Glade, Fisher, and Cayuse. Table 20 of this chapter shows the miles of stream by valley segment type for the Fisher Creek Subwatershed. Dominant valley segment types for this subwatershed include Incised glacial till and u-shaped glacial troughs. Other valley segment types identified include alluvial fans, moderate slope bound valleys, alluviated mountain valleys, lava flow/spring fed meadows and valleywall/headwall tributaries.

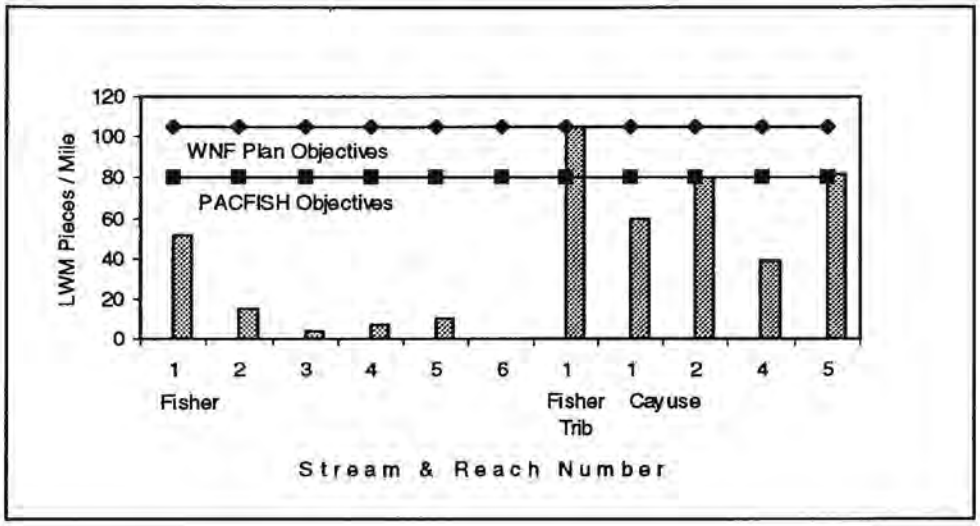
LARGE WOODY MATERIAL

Large woody material is generally common in streams within the valley segment types located in this subwatershed. The majority of large woody material would be expected to occur as individual pieces and small debris jams although reaches located in subalpine areas have little natural large woody material due to the increased incidence of fire in this area, the slower growth of conifers at high elevations, and the typically faster deterioration of tree species growing in these areas. Areas such as the Fisher Creek drainage may be naturally low in LWM due to the high frequency and intensity of wildfires. Large woody material levels are low throughout Fisher Creek and Cayuse Creek (Figure 17 of this chapter). There were 66 debris jams in this subwatershed, but 91.9% of the streams surveyed did not meet WNF Plan objectives for large woody material. Information on the number of pieces of large wood per mile was not collected for Glade creek.

Table 20: Valley Segment Types for the Fisher Creek Subwatershed (241)

Valley Segment Type	Miles	%
Alluvial Fan (2)	0.6	5.3
Incised Glacial Till/Colluvium Deposits (5)	4.9	53.4
Moderate Slope Bound Valley (6)	0.3	2.7
U-Shaped Glacial Trough (7)	4.1	36.3
Valleywall/Headwall Tributary (8)	0.4	3.5
Lava Flow/Spring Fed Meadow (9)	0.6	5.3
Alluviated Mountain Valley (10)	0.4	3.5

Figure 17: Instream Large Woody Material (LWM) for Fisher / Cayuse Subwatershed (241)



LARGE POOLS

Pools per mile are below minimum objective values for Fisher and Cayuse Creek. Information on Glade Creek was not collected. Dominant substrates for this subwatershed include gravel and cobble in Fisher Creek and cobble and small boulder in Cayuse Creek. Large woody material would be expected to be important for large pool formation (especially in Fisher Creek). The lack of large wood may explain the low numbers of large pools.

CHANNEL STABILITY

Channel stability for this subwatershed is rated as good. There were 7 documented sites of mass wasting in the first two reaches of Fisher Creek and one of its tributaries. Stream survey data indicates no other documented mass wasting in the subwatershed.

UPPER NORTH FORK SUBWATERSHED (242)

No streams in this subwatershed were surveyed. For discussion of the main stem upper North Fork see the section on physical and biological characteristics of the North Fork.

WALDO LAKE SUBWATERSHED (243)

One of the unique qualities about the Waldo Lake Subwatershed is that there are no perennial streams flowing into Waldo Lake.

LAKES

Reference Conditions

The North Fork Watershed contains hundreds of lakes located primarily within wilderness areas. The majority of lakes were formed by glacial scour with a relative few formed by earth flow dams. Nearly all of the lakes are located above 4,500 feet in elevation and primarily in the Upper North Fork (Watershed 24). Nearly all lakes within the watershed had no naturally occurring populations of fish.

Current Conditions

Many lakes have been stocked with brook trout, rainbow trout and cutthroat trout. Some lakes contain naturally reproducing populations of trout while others are stocked regularly by ODFW. With the exception of Waldo Lake, little is known about the limnological and biological parameters of lakes within the watershed due to limited data collection. Since the majority of the lakes are located within wilderness areas, most have only minor impacts from management activities.

WALDO LAKE

Of the many lakes in the watershed, Waldo Lake is the largest and most unique. Waldo Lake, located at an elevation of 5,413 feet in the central Oregon Cascade Range is one of the largest natural bodies of water in Oregon. The major sources of water entering the lake comes from direct precipitation and snowmelt runoff (Johnson et al., 1985). Waldo Lake is thought to be one of the purist lakes in the world based on comparing water chemistry and biological standards to those of other lakes that are classified as being oligotrophic (Larson and Donaldson, 1970, and Larson, 1972). Oligotrophy implies that the biological production in the lake is restricted by a relatively poor supply of dissolved nutrients (Goldman and Horne, 1983). Nutrient concentrations in Waldo Lake fit this definition. Larson (1970) compared the water chemistry of Waldo Lake to that of industrial grade distilled water.

GEOLOGIC HISTORY OF THE WALDO LAKE BASIN

Reference and Current Conditions

The physical and chemical nature of the water is determined by the geochemistry of the basin, the climate, and the morphometry of the lake (Larson, 1970). The geologic history of the Waldo Lake Basin is in part responsible for the ultra- oligotrophic nature of Waldo Lake. Basin formation is commonly attributed to glaciation (Larson and Donaldson, 1970) yet after intensive study of the geology of the basin and the batthemetry of Waldo Lake, Priest and Vougt eds.(1982) suggest that the lake was formed by volcanic activity originating from geomorphic features now known as the Twins, located on the eastern shoreline of Waldo Lake. The presence of glacial drift on the southern shore of the lake suggests that glacial activity did occur in this area, but it is not thought to have been the major forming factor responsible for the current state of the Waldo Lake Basin.

WATER QUALITY

Reference and Current Conditions

Since late in the 1960's, several studies have been conducted on the physical, chemical and biological characteristics of Waldo Lake. The data from several studies support findings indicating the lake has extremely low primary productivity and low concentrations of chemical constituents. All chemical constituents have been found in very low concentrations and in the majority of cases below laboratory detection capabilities (Lider et al. 1980). Recorded low alkalinity and pH values (5.3 to 6.7 as reported by Maleug et al. (1972), Lider et al. (1980), Carter et al. (1966) and Larson and Donaldson (1970)) indicate the lake has a very low buffering capacity. Due to the extremely low concentration of nutrients found in Waldo Lake, is highly sensitive to inputs of even relatively small amounts of nutrients.

To address the concern of potential impacts to water quality generated from developed recreational use, a cooperative study by the U.S. Forest Service, Federal Water Quality Administration (now the Environmental Protection Agency), and the Pacific Northwest Water Laboratory (now the Pacific Northwest Environmental Research Laboratory) was conducted from June to October of 1970 (Tilstra et al. 1973). This study focused on the potential impacts to the lake from a septic tank treatment and disposal system at Islet Campground located on the east shore of the lake. The authors of this report concluded that during the study period no septic tank effluents entered the lake indicating the main aquifer at this site is not connected to the lake. However, the authors indicate that the septic tank system could fail as a result of inadequate maintenance, and/or bacterial biomass clogging the fractures between bedrock layers resulting in the septic tank effluents flowing along the soil-bedrock interface into the lake. In addition, due to limited permeability of the aquifer during periods of high natural recharge, such as snow melt or during wet summers, under these conditions effluents would probably pass along the soil-bedrock interface into the lake. Because of the fragility and inherent possibility of effluent being routed to lakes on volcanic soils such as those found in the Waldo Lake area, special precautions should be taken in the design and location of waste disposal systems located adjacent to the lake.

The comfort station in Islet Campground was estimated in the 1970 study to have a design capacity of 100 persons per day. The average daily use rate of Islet Campground at the time of this study was estimated at 25 persons per day. The waste flow during the study was increase to nearly approximate the design capacity by adding fresh water to the system at a rate of 1 gallon per minute from an open faucet. This study considered only one of three septic tank and drain field locations in the campground.

During the 1994 summer season, use rates for Islet Campground were estimated to be approximately 100 persons per day on the average weekend and 275 persons per day during the peak Labor Day weekend (Jensen 1995). Given that there are three comfort stations in the campground and assuming nearly equal use of all facilities, the septic tank treatment systems currently in use may reach or exceed their designed capacity at times during peak use. In addition to the three septic tank systems at Islet Campground, seven additional comfort stations with septic tank systems are located adjacent to Waldo Lake; four at Shadow Bay Campground and three are located in North Waldo Campground. Both Shadow Bay and North Waldo Campgrounds have received similar or higher increases in their use rate since the 1970 study (see Figure 2 of Interpretation chapter). If effluent from these septic tank treatment systems reached the lake it would have the potential to affect water quality by delivery of nutrients to the lake above natural levels.

Other potential sources of pollution into the lake include petroleum products washed from the surface of three boat ramps adjacent to the lake, sediment from roadside ditches leading to the boat ramps, sediment from heavily used developed and dispersed recreation sites, numerous pit toilets located in campgrounds, and the from the use of outboard motors on the lake.

Preliminary analysis of monitoring data collected from 1969 through 1994 and received by the Forest in August of 1995, indicates a substantial increase in primary productivity of Waldo Lake as measured by an increase in phytoplankton productivity (Larson, 1995). Increases in zooplankton populations were also noted. Increases in primary productivity are associated with an increase in the availability of dissolved nutrients. The preliminary data indicates increasing values of primary productivity have occurred during the last five years. The cause of this apparent increase in primary productivity is not known. Currently there is no documented evidence linking anthropogenic sources in and around the lake to a change in water quality.

No water quality monitoring of Waldo Lake is planned for the 1995 summer season by the Willamette National Forest. In addition, there is currently no approved long term water quality monitoring plan for Waldo Lake. The Forest has supported collection and analysis of monitoring data from the Waldo Lake in the past and is expecting a report documenting analysis of existing data by October of 1995.

OTHER LAKES

WATER QUALITY

Reference Conditions

The lakes in this watershed undoubtedly contained high quality water prior to management activities and recreational use.

Current Conditions

Limited water quality or other condition information is available on other numerous lakes within the North Fork Watershed. Due to the concentration of recreational use associated with several of the lakes including some within wilderness areas, water quality could be affected due to the loss of shoreline vegetation and/or impacts from livestock use within riparian areas.

AIR QUALITY

Reference Conditions

Prior to forest management, air quality was pristine during the late fall, winter, and spring. Since fires were not suppressed, air quality could often be quite degraded during summer and early fall when wild fires burned. With no fire suppression, fires could burn for months and visibility was often very limited by smoke from a large number of smoldering to quickly moving fires.

Current Conditions

The Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, Volume I, states in Chapters 3 & 4 (USDA, USDI, 1994b, pages 96-98) that for the selected Alternative 9, PM10 emissions and Total Suspended Particulates (TSP) emissions have dropped and currently exceed the goal of 50 percent reduction of these emissions by the year 2000 for the State of Oregon. This reduction will allow for fire use and will not compromise our ability to reach prescribed burning emissions reduction goals. The production of smoke from wildfires is considered natural and acceptable by air resource managers. Therefore wildfire smoke does not influence the regulations of prescribed fire emissions. In the publication "A First Approximation of Ecosystem Health on National Forest System Lands", (Pacific Northwest Region, June 1993), an assessment was completed that compared smoke emissions and acres burned annually from pre-settlement times to current smoke emissions due to wildfire and prescribed fire. For Western Oregon, historic estimates were more than double current estimates of PM10 emissions and acres burned.

Biological

VEGETATION

AGE CLASS / SUCCESSIONAL STAGE DISTRIBUTION

Vegetation is always changing, and is difficult to typify as a result of its dynamic nature. To a large extent the following discussions compare two snap shots in time, one before large scale harvesting began in this watershed, and one that exists after 70 years of harvesting has occurred. It should be kept in mind that these two periods of comparison are not absolute. As discussed in the Fire History section of the Characterization chapter, there may have been times when a majority of the watershed was occupied by young stands after very infrequent, regional scale, wildfire. The central point of the following comparisons is that under natural conditions the vegetation was occasionally heavily

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Reference Conditions

200 years ago (before European influence at least in terms of the vegetation and fire frequency) about 10 to 15 percent of this watershed was occupied by early successional, or stand initiation stage, forests. There was relatively little edge between early and late successional forests in this historic landscape. The early successional forest and edge were created by wildfire that burned large areas, both as stand replacement fire and as underburns. The amount of forest fragmentation before fire suppression and timber management can be seen in Figure 18 of this chapter.

Conversely, 45 to 60 percent of this watershed was composed of late-successional forest. Mid-successional forests, those representing the stem exclusion and understory reinitiation stand development stages, occurred on about 30 to 40 percent of the area.

The watershed probably had more non-forested acres due to repeated fire that created and maintained large meadow complexes along ridge tops but this percentage was probably not much larger than it is today. Aboriginal burning was probably also responsible for a greater amount of meadows along the river bottom (such as the Brock Meadow and Major Prairie areas, as evidenced by stands from 80 to 150 years old in areas otherwise occupied by old-growth forests) and in some areas, likely south slopes near main campsites, the forest was very open and park-like due to repeated underburning.

Current Conditions

Approximately 15 percent of the watershed is composed of early-seral stands in the stand initiation stage of development. This percentage is essentially the same as what existed in prehistoric times but it is distributed quite differently across the watershed. Nearly all the current early successional forest occurs in the western portion of the watershed while two hundred years ago there was a much higher percentage of early successional forests in the eastern portion of the watershed. Current early successional forests are for the most part the result of dispersed regeneration harvest activities and as such create much more edge and associated fragmentation of interior habitat (see Figure 19 of this chapter).

Current amounts of mid-seral habitat across the watershed are 16 percent in the stem exclusion stage and 30 percent in the understory reinitiation stages. About 40 percent of the watershed currently consists of late-seral forests, again a similar amount to what has existed before management began but like early successional habitat, this late-successional forest is more scattered throughout the watershed and much more fragmented than it once was.

As the result of the seven decades of past harvest and the incidence of wild fire as discussed in the Chapter I, this watershed has a very diverse set of age classes as shown in Table 21 of this chapter.

Table 21: Acres by Structural Stage - With Associated Stand Age Range

Structural Stage	Circa 1900	Current Condition
Stand Initiation (0 - 30 years) (early successional)	20,659 acres (14%)	22,168 acres (16%)
Stem Exclusion (30 - 80 years) (mid successional)	18,795 acres (12%)	22,637 acres (16%)
Understory Reinitiation (80 - 200 years) (mid successional)	approx. 40,000 acres (29%)	41,510 acres (30%)
Old Growth (200 plus years) (late successional)	approx. 60,700 acres (44%)	51,639 acres (38%)

Most the acreage of younger, early successional current condition forests shown in Table 21 have been created after harvesting. Forest management policy has changed considerably in the years since the first clearcut was implemented in the North Fork. The first harvesting occurred in a pattern very similar to how wildfires tended to burn. Subsequent public concern with large clearcut areas resulted in law and agency policy directing management to avoid the creation of large openings in the forest. After about 1940, regeneration harvesting was limited in size without a concurrent reduction on harvest volumes, resulting in widespread fragmentation of the previously unfragmented forest. Widespread partial harvest to salvage expected mortality in mature and old-growth stands occurred from the 1950's to the 1980's to also minimize the openings created by harvest. This partial harvesting may have imitated somewhat the effects of low intensity fire in terms of canopy closure and numbers of live trees per acre. However, it did remove stems that would have remained on site, and compacted the soil, two results that do not have an analog in the natural system.

The numbers in Table #21 reflect the amount of various age and structural classes but not their distribution. The following section on Terrestrial Wildlife Habitat discusses the extent and implications of the fragmentation and structural changes that have occurred in these forests.

As mentioned previously, about 32 percent of this watershed has been more or less severely disturbed as the result of regeneration harvesting. Approximately 25 percent of this harvest was accomplished by ground-based skidding machinery that has the potential to compact soils. Past harvesting has most certainly had some affect upon the long-term site productivity

OVERALL DIVERSITY OF VEGETATION

Reference Conditions

The pattern and timing of fire on this landscape created a relatively diverse complex of vegetation assemblages and structural conditions. Fire periodically created new early successional communities, and areas that did not burn frequently gradually developed late-successional characteristics that in some areas persisted for centuries before stand replacement fire eventually returned. Repeated fire, to an unknown extent the result of aboriginal burning, created and maintained many meadow complexes on ridge tops and on the north edge of the river bottoms.

Current Conditions

While certain types of plant communities are not as widespread as they once were (for example late-successional forest, or dry meadows), they still exist in fairly large percentages of what existed 200 years ago. Neither the suppression of fire nor the harvest of trees has yet to eliminate any specific plant communities from this watershed, though fire suppression has resulted in a reduction in the acreage of meadows and timber harvest has resulted in a reduction in the acres of late-successional forests.

Figure: 18a
Historic Seral Stages

Lower North Fork Middle Fork
Willamette River Watershed

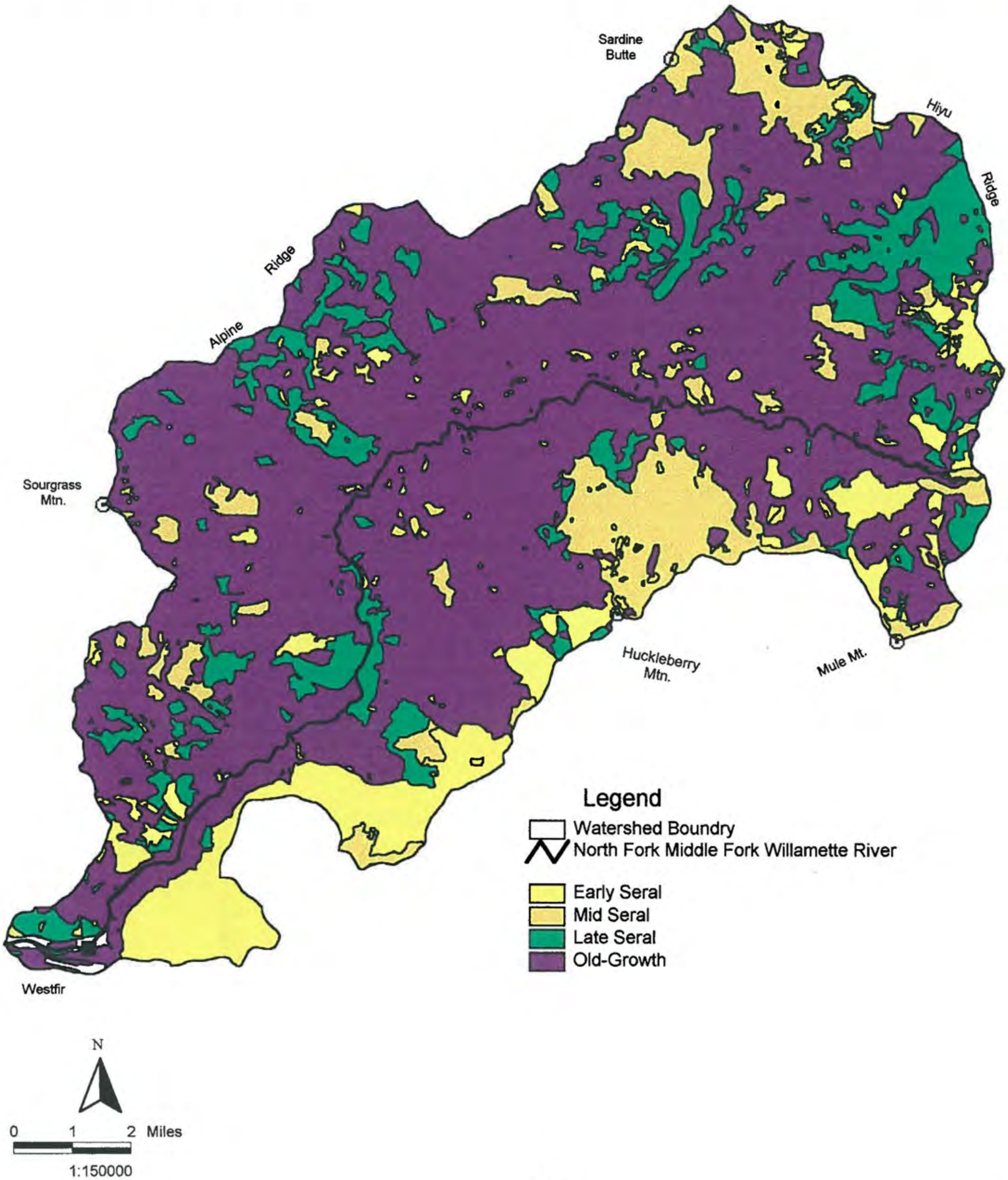


Figure: 18b
Historic Seral Stages

Upper North Fork Middle Fork
Willamette River Watershed

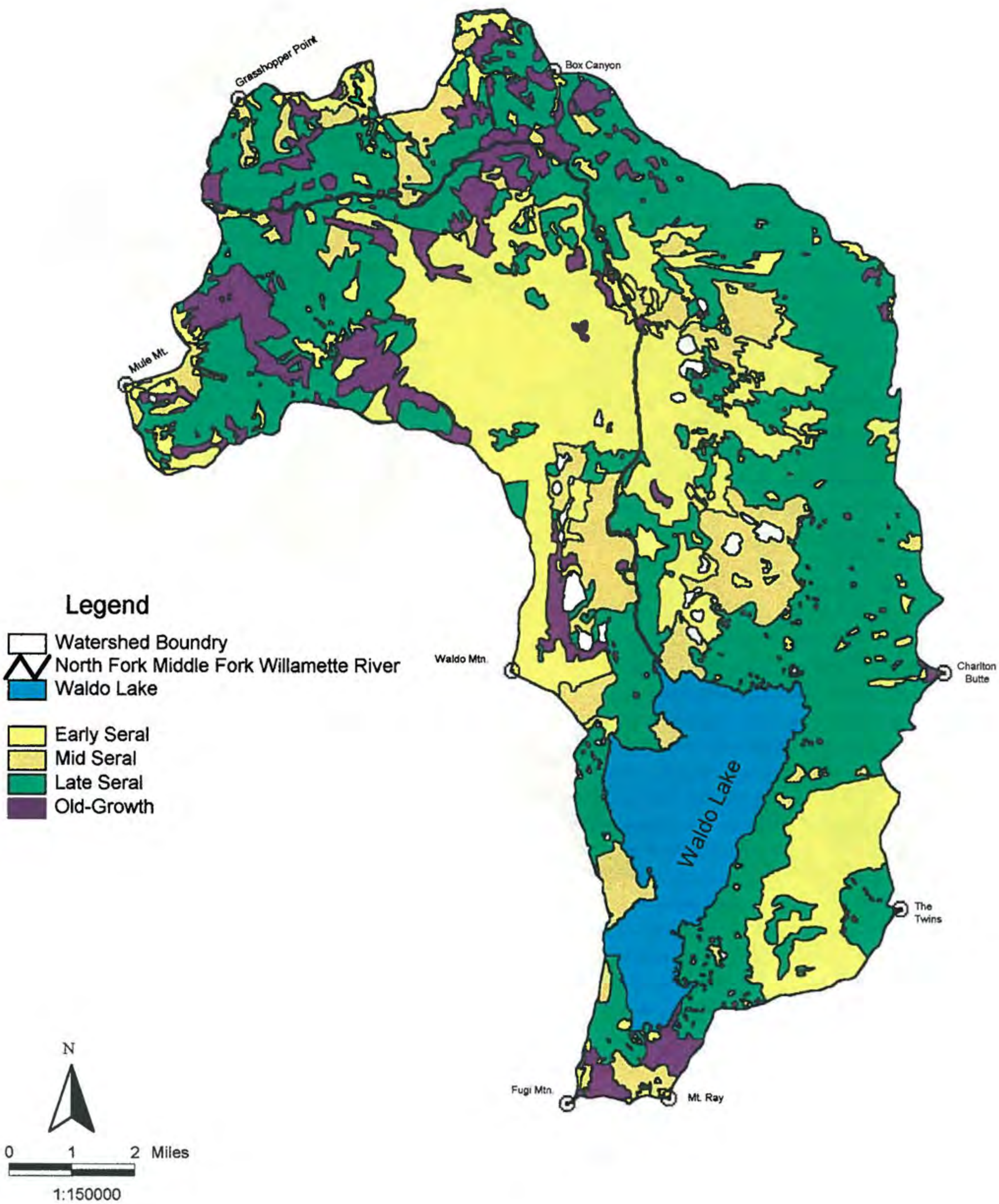


Figure: 19a
Current Seral Stages

Lower North Fork Middle Fork
Willamette River Watershed

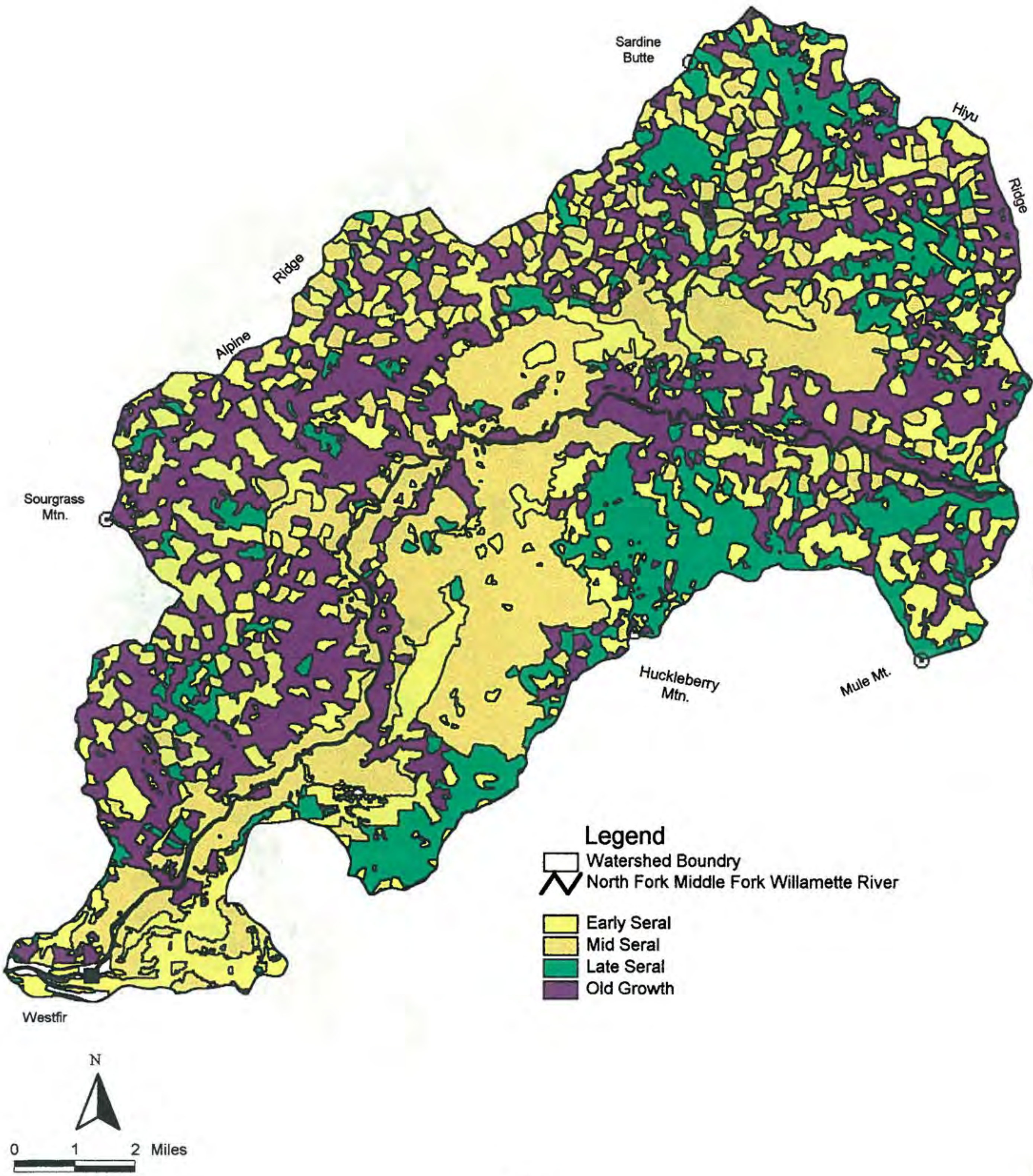


Figure: 19b
Current Seral Stages

Upper North Fork Middle Fork Willamette River Watershed

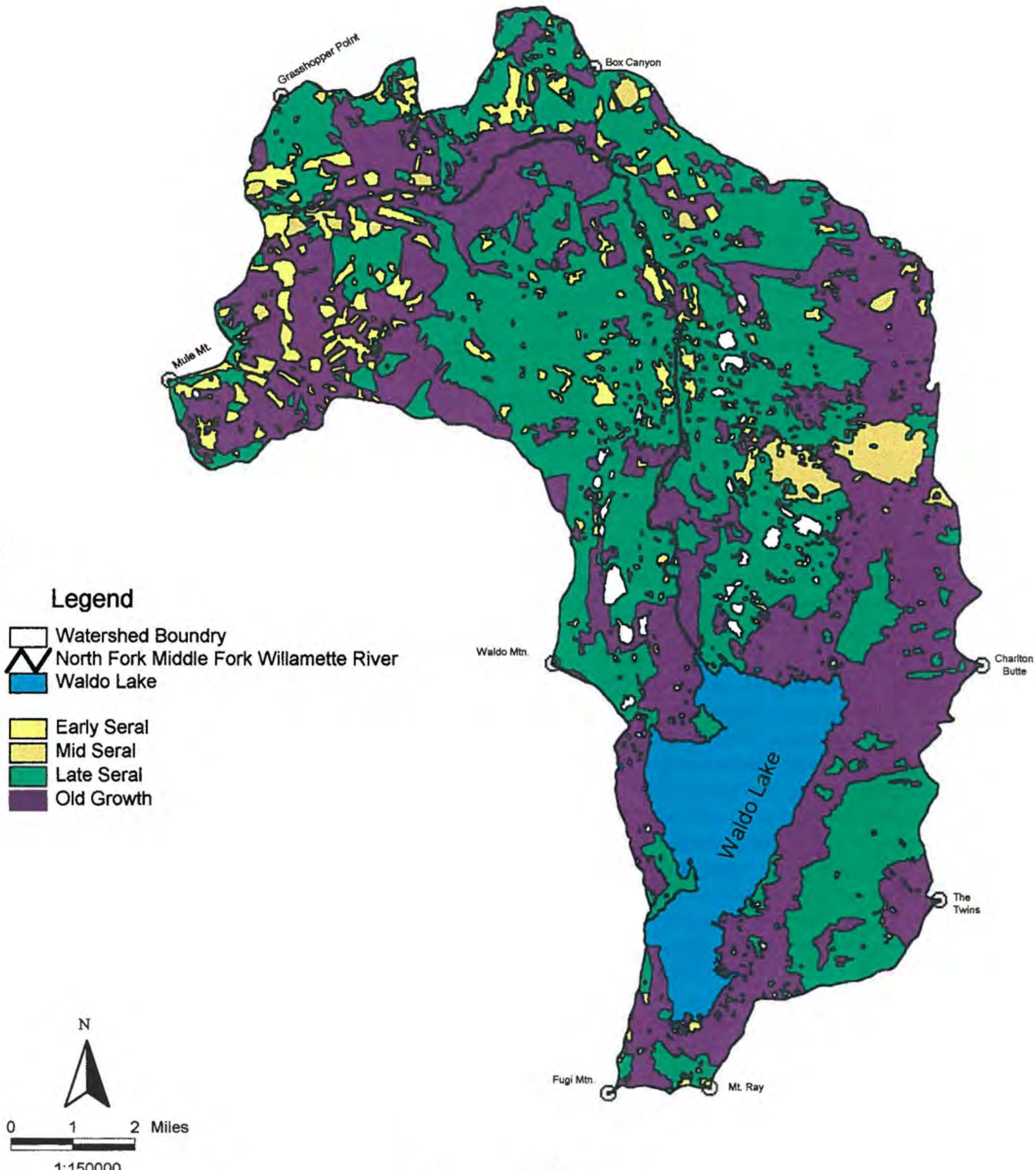


Figure: 20a

Special Habitats and Potential Special Habitats

Lower North Fork Middle Fork Willamette River Watershed

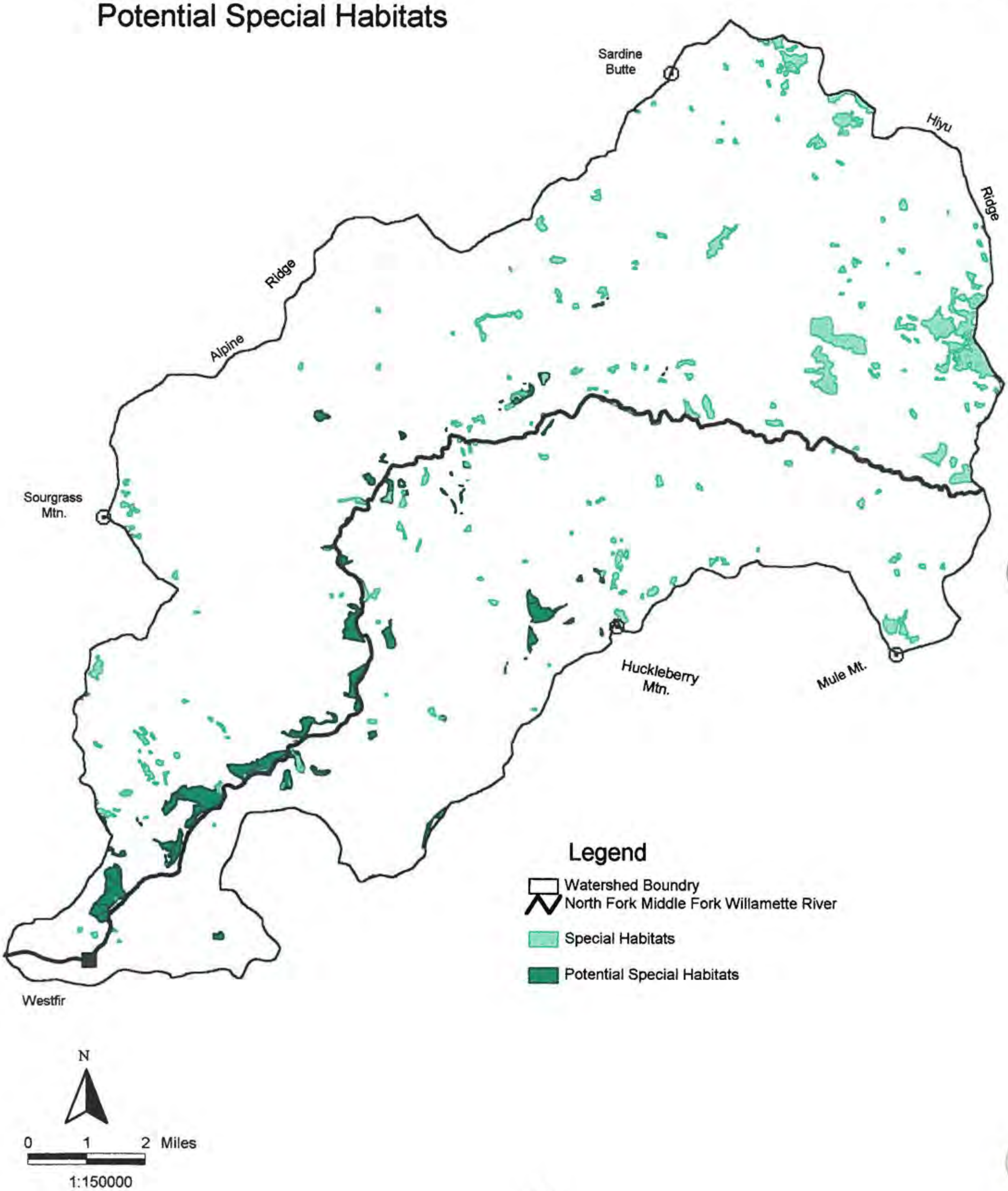
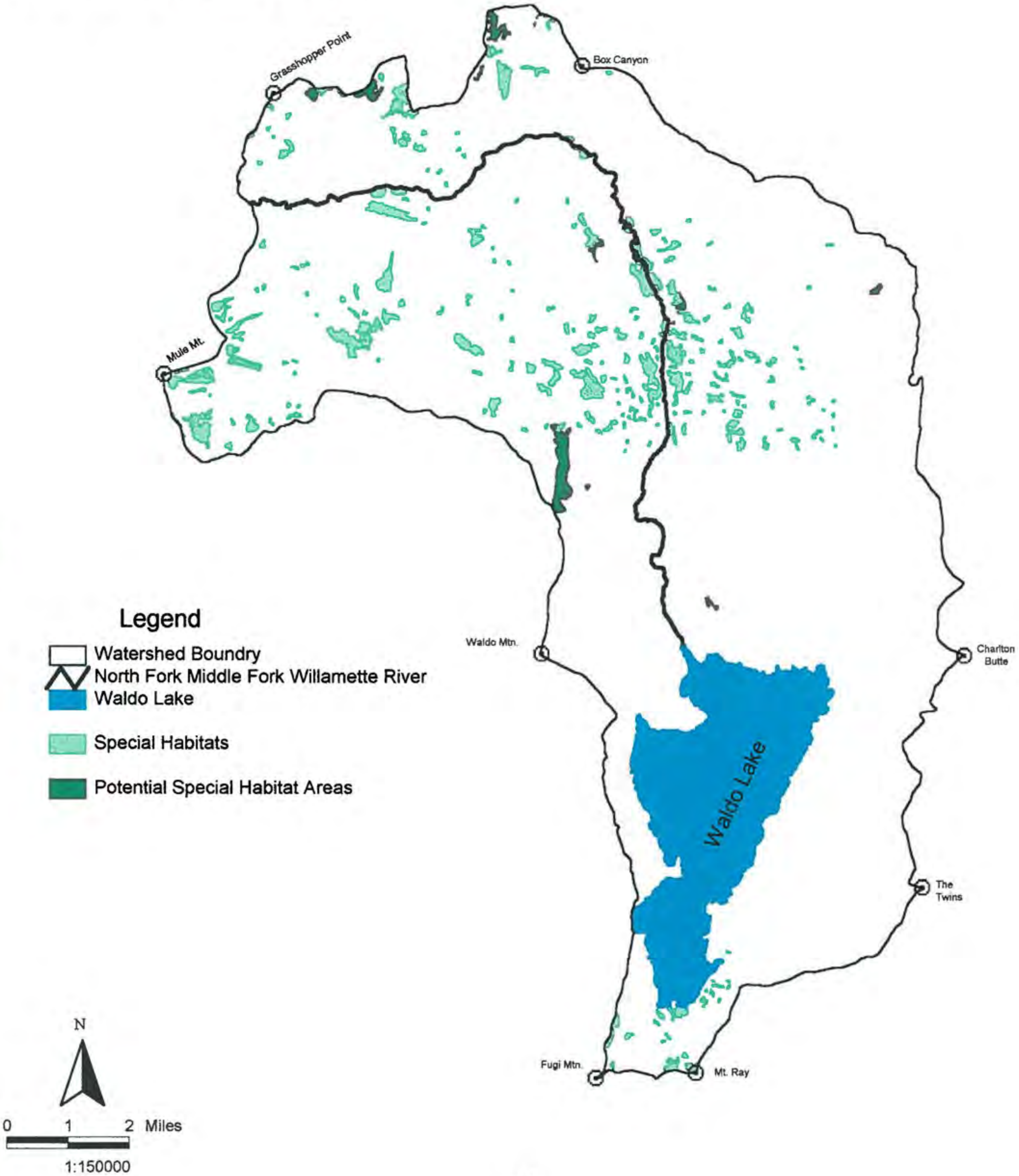


Figure: 20b
Special Habitats and Potential Special Habitats

Upper North Fork Middle Fork Willamette River Watershed



The structural diversity of some young stands regenerated after harvest may be less complex than other natural young stands, but natural young stands sometimes reburned, resulting in low structural diversity. Some young managed stands were planted with mostly Douglas-fir and/or precommercial thinning was designed to select against trees other than Douglas-fir, but this stand composition can also be found in natural young stands regenerating after fire.

The main effect that management activities have had on vegetational diversity is an increase in stand edge (fragmentation) as mentioned above. Harvesting and associated road construction has increased the amount of edge habitat (the effects of which are fully discussed in the following section on wildlife habitat), decreased the amount of late-successional habitat, has changed the distribution of late-successional habitat, accelerated the establishment of non-native plants, and may have created non-forest vegetation types that would not have existed otherwise. Fire suppression has decreased the extent of meadows, and may have resulted in some areas of late-successional forest that would not have existed otherwise. Management activities have had no appreciable effects upon the overall age class percentages, though fire suppression has resulted in greater areas of older forest in Watershed 24 and harvest has resulted in lesser amounts of late-successional forests in Watershed 17.

SPECIAL AND UNIQUE NON-FORESTED HABITATS (SHABS)

Reference Conditions

It is suspected that prior to European settlement Native American populations used fire as a tool to create or perpetuate meadow habitat in order to maintain early seral conditions for longer periods than natural fire intervals would have, thereby increasing vigor and productivity for berries, roots and associated wildlife use. Forested areas were likely underburned in places to also provide more productive animal forage and to facilitate travel. Several non-forested meadows in the watershed including Grasshopper Meadow, Major Prairie, and Brock Meadow have undergone past modifications to habitat diversity in the form of post-settlement use. A representation of potential non-forested openings on fire prone aspects and soils (Figure 20 of this chapter) in stands less than 90 years of age was compared with a current map of non-forested special habitats. The comparison suggests that fire events could have contributed towards the development of a larger amount of non-forested acres than what might have developed without fire suppression. Past livestock grazing, logging history, and loss of fire all contributed to changes in the diversity, composition and function of the plant communities.

Current Conditions

Seventy to eighty years of natural fire suppression activities may have modified the watershed landscape by contributing to a reduction in the fire maintenance regime that influenced meadow opening size and abundance. Subsequent conifer invasion has since been occurring, being particularly prevalent on ridge line meadows where repeated lightning ignited burns may have maintained meadow conditions. Vaccinium membranaceum/Xerophyllum tenax communities present in the upper elevations of the watershed are examples where fire is thought to have played a key role in producing non-forested openings in drier mountain areas (Franklin and Dyrness, 1988). The vegetation may be more diverse now that it was prior to management in terms of early successional herb/shrub communities created by harvest. However, these communities are relatively ephemeral as shrubs and sapling trees tend to dominate such sites quickly.

The above mentioned meadows were included in major grazing allotment ranges on the district. The effects of grazing contributed to maintaining more open conditions in meadows, and prior to cessation of grazing, it is assumed that the total meadow acreage was higher around the turn of the century. Historical records indicate cattle were grazed in the mid 1860's, District records show cattle and sheep were grazed in the late 1800's and early 1900's. Grasshopper meadow is an example of where tree encroachment has been taking place and is contributing to loss of meadow habitat. The Grazing Policy Statement for Grasshopper in the 5-year period between 1946 and 1950 describes conifer encroachment taking place "Conifer encroachment on the Grasshopper cattle allotment is taking it's annual toll on this range" (Miller, 1994). Conflicts of use were reported due to Incense cedar encroachment (USDA, 1968). Grasshopper meadow had been subject to heavy cattle and sheep grazing in the past; allotment records span from 1915-1976. Effects from grazing are still evidenced by areas where erosion took place and by the presence today of non-native species. Erosion control work in the mid 60's was done to help mitigate the effects of allotment use (USDA, 1979). Weed eradication took place using 2-4D on 65 acres in 1966 and reseeding and fertilization by hand in 1967 (using Orchard grass, Big Bluegrass and Alta fescue) (USDA, 1968). Non-native timothy grass is also present in the meadow.

The watershed has not yet been extensively surveyed for SHAB types and associated floristic inventories. Sampling is usually accomplished when associated with site specific projects.

SENSITIVE AND RARE PLANT SPECIES

Reference Conditions

The historic distribution of sensitive and rare plant populations is assumed to be generally similar to that of today with the exceptions discussed in the following narrative. Figure 1 of the Characterization chapter (chapter I) would suggest that those higher frequency, stand replacing, fire prone areas contributed to a higher abundance of non-forested patches and underburned areas maintained by more frequent fire events.

Current Conditions

Several types of natural openings and forested lands found in the watershed are habitat for plants currently listed as sensitive by the Region 6 Regional Forester's TES Plant List. See Appendix H for a list of potential habitats for sensitive plants. Two plants on the sensitive list occur within the watershed.

Succession in the form of tree encroachment into meadows and tree canopy closure, possibly increased by fire suppression (where low intensity natural ground fires partly contributed to more open understory), may be excluding the Umpqua swertia, Frasera umpquaensis from it's meadow and forest edge habitat and may be a long-term concern (USDA and BLM, 1993). The Woodland milkvetch, Astragalus umbraticus and Branching montia, Montia diffusa, whose germination is influenced by fire, may have occurred more frequently, following closely after fire events. No occurrence of woodland milkvetch has been discovered in the watershed to date. However, it may be that this plant extended its currently known range into the watershed prior to fire management activities, based on recent documentation of its occurrence in the Warner Fire Area in 1993. The central range of this species is in the Umpqua NF, just to the south of the Rigdon District. An assumption is made that the North Fork and the Middle Fork of the Willamette and the Umpqua watersheds may have contained connected populations. The branching montia, documented south of the North Fork Watershed could have likely existed in similar habitat in greater abundance in the North Fork. Thompson's mistmaiden (Romansoffia thompsonii) is restricted to rocky substrates with minimal soil development and a dependence on seasonal moisture in rock garden/dry openings. It is likely that fire did not play as critical role in maintaining such habitat, though quarry excavation may have affected localized populations or potential habitat.

Additional rare plant species occur in the watershed. Some, like most sensitive plants in this ecosystem, are found within non-forested habitats while others occur in forested habitats. Six species listed on the Willamette National Forest Watch and Concern Lists are located within the watershed. These species are usually located and tracked along with sensitive plant inventories and other botanical inventories conducted in the Wilderness, Special Interest Areas, and other non-timber production Management Areas. See Appendix H for a listing of rare and unique plants in the watershed.

SURVEY AND MANAGE SPECIES: FUNGI, MOSSES, LICHENS, AND VASCULAR PLANTS

Reference Conditions

The historic representation of the pattern of the watershed landscape fire history (Figure 1 of the Characterization chapter, chapter I) suggests that the western half developed into larger old-growth tracts of forest with patchy fire occurrences prior to extensive logging and fire suppression, during which time longer intervals occurred between large scale fire events. Species diversity and richness in old-growth dependent and riparian-dependent communities would have had more time to develop before increases in early seral stages were brought about by extensive timber harvesting. The eastern half of the watershed displayed a higher frequency of stand replacing fires, leaving residual patches of old-growth in a more isolated pattern, thereby leaving old-growth associated species relegated to riparian areas and refugia such as basins, valley bottoms and ridge line breaks where a higher level of downed woody debris and snag development remained (see Figure 18).

Current Conditions

Late successional species habitat in Watershed 17 has declined due to extensive harvest of old-growth stands and associated road building. The remaining old-growth in the watershed is concentrated at higher elevations or in relatively small areas associated with previous spotted owl reserves and, in many areas highly fragmented (see Figure 19). Many Survey and Manage Species have limited dispersal capabilities, thus gene flow may be restricted between populations in fragmented habitat areas. Management for single species plantations after harvest in riparian forests along with adjacent upland stands has contributed to a simplification of species richness in plant communities. See Appendix H for a list of Survey and Manage Species.

Survey and Manage Species have not yet been systematically inventoried in this watershed. The Regional Ecosystem Office species location information and survey protocols will be released in 1996. Existing biological and ecological information is minimal for most of these species. However, it reasonable to assume that if systematic surveys were conducted for old-growth dependent species, a much larger number would be found in the watershed.

The rare semi-aquatic leafy liverwort, Marsupella emartinata var. aquatica, grows on rocks in the splash zone of the Waldo Lake outlet. This is the only documented occurrence in Western North America.

NOXIOUS WEEDS AND OTHER NON-NATIVE INVASIVE PLANT SPECIES

Reference Conditions

Those non-native plant species legally designated as noxious, mean "any weed designated by the Oregon State Weed Board that is injurious to public health, agriculture, recreation, wildlife, or any public or private property" (ODA, 1995). Several detrimental effects are included as the basis for criteria for rating and classifying weeds as noxious, one being "a plant species that is or has the potential of endangering native flora and fauna by its encroachment in forest and conservation areas" (ODA, 1995). Most northwest weeds are originally native to Europe or Asia and were introduced intentionally or by accident. Noxious weeds and other invasive non-natives have the potential to alter native plant communities as they are able to displace and out compete native species. They are opportunists with broad ecological tolerances, can grow under a wide range of climatic and soil conditions, and have excellent reproductive capabilities (Taylor, 1990).

No noxious weeds were present prior to European colonization. Non-native plant species have been introduced into Oregon since settlers began bringing them in accidentally or for various uses. The advent of large-scale logging and road building in the 1930's produced a large increase in the spread of non-native plants. Livestock grazing also contributed to the spread of some noxious weeds.

Current Conditions

Weed competition with native plant species is occurring in reforestation project areas, wildlife use areas (including small wetlands and river flood plains) and road rights-of-way. It has also been noted that some weeds are extending into natural dry/moist meadow openings and rock garden communities. In many areas, non-desirable weed species are excluding native plants to the point of forming dense weed patches and thickets.

Non-native plant species play a significant role in influencing changes to native plant communities. Many noxious weed species and other non-native invasive plants are found in the watershed. Many of these species are firmly established and have been for some time now. Some are currently increasing in extent largely due to logging and road building practices that act as dispersal mechanisms. See Appendix H for a list of noxious weeds present in the watershed.

Invasion of non-native plants in the watershed is a serious threat to native plant abundance. The Willamette National Forest Integrated Weed and Management Environmental Analysis lists 7 site types where a potential exists to harbor noxious weeds already established on the forest and potential invader weeds. All of these site types are found within the watershed. Site types range from bare, rocky, gravely ground such as road beds, quarries, etc., to floristically diverse areas such as meadows, sensitive plant sites, wetlands, etc., (see the EA for full descriptions).

Major forest roads and other corridors, such as right-of-way clearances serve as noxious weed dispersal pathways and establishment sites. Aufderheide Drive (FS Road 19) is a well-used travel-way by which vehicular, mechanical, and wind-born weed seed transport and spread has occurred. Timber sale units, associated roads and landing sites, trails, and other disturbed openings have seral conditions that typically support weed populations. Other spread mechanisms in the watershed include bird and mammal seed dispersal, livestock and their feeds, and weed seed contamination of forage and erosion control seeding mixes.

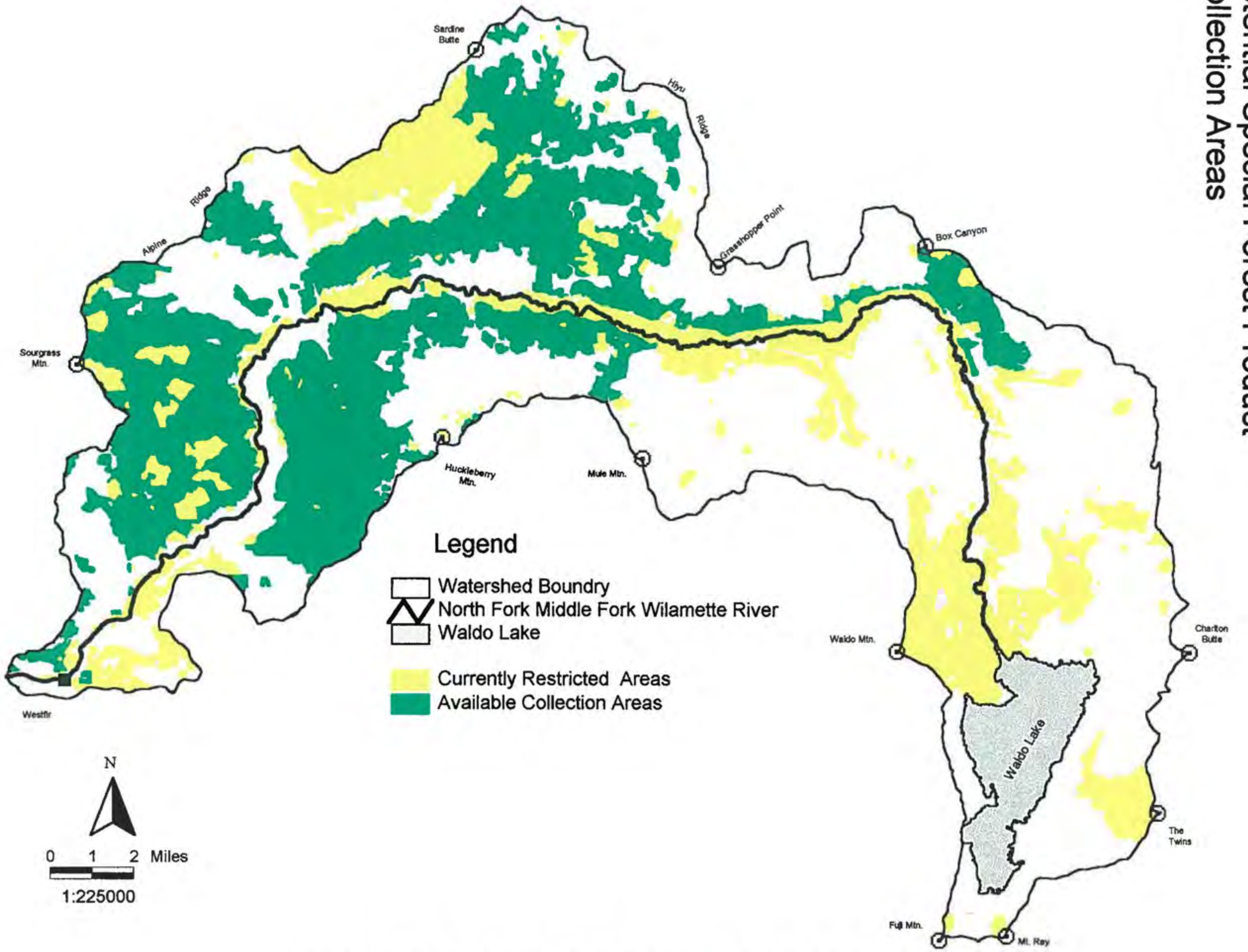
Roadside inventories on the Oakridge Ranger District of noxious weeds were conducted by the ODA in 1988 and again in 1993. The results of these inventories have shown that some noxious weed species have increased in an alarming rate of spread. For instance, scotch broom is estimated to have infested an additional 35 percent of the area since the 1988 survey and the number of roads infested has increased to 51 percent (Miller, 1993).

<u>SPECIAL FOREST PRODUCTS</u>

Reference Conditions

Special Forest Products have long been gathered for traditional native American and folk use.

Figure: 21
Potential Special Forest Product Collection Areas



North Fork Middle Fork Willamette River

Current Conditions

A forest-wide programmatic special forest product environmental analysis was completed in 1993 that provides the framework for decisions on the collection of special forest products. Willamette Forest Plan Amendment No. 23 allows commercial collection in all lands open to commercial timber harvest.

Many miscellaneous non-convertible special forest products (SFPs) found in the watershed are frequently requested by local and non-local collectors for personal and commercial use, and due to the growing interest in the SFP industry as a source of alternative income. These plants will continue to be an important part of future forest resource use.

No formal SFP inventories have been done on the district for species with economic potential. Therefore, limited information is available that establishes specific locations, quantities and qualities available, accessibility, etc. for such species. Several types of plant communities in the watershed contain products of marketable quality, such as ornamental cuttings, transplants, boughs, and floral greenery products.

Forested plant associations and other habitat types were surveyed for this analysis to get a general sense of where several species that have been commonly asked for might be found in sufficient amounts to be gathered for commercial purposes. See Figure 21 of this chapter for the distribution of these plant associations. The following is a preliminary list of those products identified in the watershed that may occur in quantities sufficient for commercial collection rates while remaining abundant enough to maintain plant populations as prescribed in the Willamette NF SFP Program standards and guidelines:

- mushrooms
- floral greens (salal, sword fern, dwarf Oregon grape, beargrass, scotch broom)
- landscape transplants (vine maple, rhododendron, manzanita, etc.)
- huckleberries
- nuts
- ornamental cuttings/crafts (willow, vine maple, ceanothus, madrone, chinquapin, Pacific yew)
- boughs
- pitchwood
- cones
- conks
- botanicals (such as prince's pine, wild ginger, wildflowers, etc.)

Lichens and moss are not currently being offered for commercial collection on the Oakridge District. "Vine maple moss", a collective term used for several species that are collected, has been harvested on the district. Several thousands of pounds of moss was sold in the late 1980's, though records are no longer available to indicate precisely how much of that amount came from the North Fork.

FUEL ACCUMULATION

Determining dead fuel accumulation is necessary to define potential fire behavior and suppression difficulty in the event of a fire. Once dead fuel loading is determined, it can be characterized into standard fuel models for predictive purposes.

Reference Conditions

This watershed is typical of a High-Severity fire regime as described by Agee (1981). Fires in this regime are very infrequent (more than 100 years between fires). They are usually high-intensity, stand replacement fires. Fires are associated with drought years, east wind synoptic weather types with lower humidity, and an ignition source such as lightning (Huff and Agee, 1990, Pickford et al, 1980). Accurate fire return intervals have never been calculated in these forests because the interval between fires are long and may not be cyclic (Agee and Flewelling, 1983). Fahnestock and Agee (1983) estimated that dryer sites may burn again after 100 years. Following a fire event, the forest then would develop through predictable seral stages. Fuel loadings typical during these stages are:

Seral Stage Description	Age Class	Fuel Model
Stand Initiation (SI)	0 -- 30	5
Stem Exclusion (SE)	31 -- 80	10
Understory Reinitiation (UR)	81 -- 200	8
Late Successional & Old Growth (OG)	200 plus	10

Fuel loading was determined by the Planar Intersect Method (Brown, 1974) and the Photo Series For Quantifying Natural Forest Residues in Common Vegetation Types of The Pacific Northwest. Stands were then categorized by National Forest Fire Laboratory (NFFL) fuel models as follows:

- Brush with 0-3 inch material less than 3 tons per acre (<3 tons per acre) was given a fuel model 5 (FM5).
- Stands with 0-3 inch material greater than 5 tons per acre (>5 tons per acre) or total tons of fuel greater than or equal to 40 tons per acre were given a fuel model 10 (FM10).
- Stands with 0-3 inch material less than or equal to 5 tons per acre and total tons less than 40 tons per acre were given a fuel model 8 (FM8).
- Stands with 0-3 inch material greater than 34 tons per acre were given a fuel model 12 (FM12).

In Watershed 17 below 4500 feet in elevation and west of the river, the fire return interval for large fires is 400+ years. This area is subject to fires less than 300 acres, primarily on south to west facing aspects. This type of fire behavior seems to be primarily due to heavily dissected topography with the North Fork running primarily north and south and fires being effected by up canyon and up slope winds. Prior to timber harvesting, large fires probably occurred when fuel loadings in old growth forests made them most susceptible to burn, regardless of elevation, aspect or slope. At elevations above 4500 feet, slopes tend to be less dissected, more uniform topography subject to effects of east winds and prevailing winds. Watershed 17 east of the North Fork to the watershed boundary is characterized by long steep slopes, not heavily dissected by steep canyons, and the area is generally not effected by east winds. Fires here would tend to be more slope driven with milder wind speeds.

Looking at fire history by century for all of Watershed 17 seems more relevant than by decade in order to get a clearer picture of current conditions compared to historic conditions. Since most of the harvesting was in late successional and old growth and accounts for 52% of this area, it can be concluded that large amounts of this area went through very large stand replacement fire episodes, with small amounts of fire disturbance in between. The percentage of this area burned in the last two centuries is relatively small. Stands regenerated by fire went through similar seral stage development and fuel loadings over very long extended periods with some evidence of small understory and stand replacement events occurring occasionally. It is estimated that during the last two centuries without timber harvest, fuel loading in this area would be approximately 3% FM5, 75% or more FM8, and 22% or less FM10 given that no large fire events occurred.

Approximately 58% of Watershed 24 has burned within the last 200 years. Stands greater than 200 years of age represent approximately 39% of the area while stands less than 55 years of age represent only 1% of area. Large fire episodes correspond with drought periods or periods when abnormally dry winters occurred. Since 1940, approximately one-half of all fires have occurred above 4500 feet in elevation and account for 94% of all acres burned. Large fire events have primarily occurred in steep, uniform V-shaped canyons running east and west where east winds are channeled and funneling of winds occur, or are above 4500 feet in elevation and exposed to east wind events. Downdrafts from thunderstorms play a significant role in fire spread on flatter ground. Stands become most vulnerable to stand replacement events when fuel loadings approach a FM10. This generally happens during the stand initiation-stem exclusion stages or during the old growth stage when fuel levels are high. In both cases, the large wood component increases due to snags falling to the ground. Given this sequence of events, expected fuel loadings would be approximately 26% FM10 and 74% FM8.

Current Conditions

It is necessary to look at both harvested stands and natural, unmanaged stands to obtain a picture of existing fuel conditions. In this analysis the term "wilderness" includes designated wilderness, Research Natural Areas, and other land allocations not managed for timber production.

Land Description	North Fork Watershed Approx. Acres & % of Acres	Watershed 17	Watershed 24	Watershed 24 without Wilderness
Total Acres	158,270	88,427	69,843	27,267
Regen Harvest	50,000 -- 31%	45,813 -- 52%	4,187 -- 6%	4,187 -- 15%
Natural Stands	65,672 -- 42%	42,592 -- 47%	23,080 -- 33%	23,080 -- 84%
Water	7,041 -- 5%	22 -- 1%	7,019 -- 10%	5 -- 1%
Wilderness	35,557 -- 22%	0	35,557 -- 51%	0

Harvested acres were categorized by Fuel Model as follows:

- Pre 1960 treated and not treated = FM 8
- Not treated 1960 to present = FM 12
- Treated 1960 to 1979 = FM 10
- Treated 1980 to present = FM 5

The following table represents the two primary fuel models for natural stands, and their estimated percentages:

Watershed 17	Watershed 24 (wilderness & non-wilderness)
FM 8 = 47%	FM 8 = 74%
FM 10 = 53%	FM 10 = 26%

The following table combines information from the previous two tables:

	Natural Regen without Wilderness		Natural Regen with Wilderness		Harvested Stands			
Fuel Model	Watershed 17	Watershed 24	Watershed 17	Watershed 24	Watershed 17	Watershed 24	Total without Wilderness	Total with Wilderness
5	0	0	0	0	6,426	1,060	7,486	7,486
8	20,015	17,087	20,015	43,490	11,191	195	48,488	74,891
10	22,570	6,000	22,570	15,154	10,263	707	39,540	48,694
12	0	0	0	0	17,933	2,225	20,158	20,158
Water	22	5	22	7,019	0	0	27	7,041

The following table shows percentage of total acres (122,713 acres) outside wilderness, since timber harvest does not occur in wilderness.

	Natural Regen without Wilderness		Harvested without Wilderness			Percent of Total	
Fuel Model	Watershed 17	Watershed 24	Watershed 17	Watershed 24	% Total without Wilderness	Watershed 17	Watershed 24
5	0%	0%	5%	1%	6%	5%	1%
8	16%	14%	9%	1%	40%	25%	15%
10	18%	5%	8%	1%	32%	26%	6%
12	0%	0%	15%	2%	17%	15%	2%
Water	4%	1%	0%	0%	5%	4%	1%

Using data from 72 natural stand plots, an attempt was made to identify trends in fuel loading verses aspect, elevation, and seral stage.

Seral Stage Description	Stand Age (in years)
Stem Exclusion (SE)	31 to 80
Understory Reinitiation (UR)	81 to 200
Late Successional and Old Growth (OG)	200+

Elevation Zones	Aspect Groups
Class Low -- less than or equal to 2800 feet	NW & N
Class Medium -- greater than 2800 feet but less less than or equal to 4000 feet	NE & E
	SE & S
Class High -- greater than 4000 feet	SW & W

		Aspect Groups				
Seral Stage	Elevation Class	NW & N	NE & E	SE & E	SW & W	Percent of Total
SE	Low	0	3	1	2	
"	Medium	4	7	4	3	
"	High	3	3	3	2	49%
"	(SE total)	(7)	(13)	(8)	(7)	
UR	Low	0	0	0	1	
"	Medium	0	0	4	2	
"	High	0	0	1	1	12%
"	total	(0)	(0)	(5)	(4)	
OG	Low	4	1	3	1	
"	Medium	4	1	0	4	
"	High	3	3	2	2	39%
"	total	(11)	(5)	(5)	(7)	

In this analysis all seral stage UR were found to be FM8 and all were found on dryer sites representing only 12% of all plots. Seral stage SE represented 49% of all plots, with no direct correlation to aspect, elevation or fuel model. Seral stage OG represented 39% of the plots with the majority occurring on NW & N aspects but no direct correlation could be found with aspect, elevation or fuel model. Use of these percentages as a target for seral stage distribution in the future or for historical significance would not be advisable. Each stand must be ground evaluated to determine its appropriate fuel model, which will change as the stand ages.

FIRE OCCURRENCE SINCE 1940

Lightning Fires Greater Than One Acre:

Aspect	Number of Fires	Number of Acres	Average Size (in acres)
NW & N	8	45.15	5.64
NE & E	4	56.84	14.21
SE & S	4	14.06	3.52
SW & W	6	11.69	1.95

Elevation (feet)	Number of Fires	Number of Acres	Average Size (in acres)
< 3000	0	0	0.00
3000 to 4500	5	88.96	17.79
>4500	8	38.78	4.85

Note: There are 7 actual fires greater than one acre but when computerized, they cover different aspects and elevation ranges.

Lightning Fires Less Than One Acre:

Aspect	Number of Fires	Number of Acres
NW & N	118	118
NE & E	73	73
SE & S	53	53
SW & W	99	99

Elevation (feet)	Number of Fires	Number of Acres
< 3000	29	29
3000 to 4500	107	107
> 4500	207	207
totals =	343	343

Total number of lightning fires was 350, total acres equals 470.74, for an average of 1.34 acres per fire.

Lightning Occurrence by Decade and Watershed:

Watershed - 17

Decade	Acres	No.of Fires
1940	22.60	22
1950	21.00	21
1960	71.09	41
1970	31.00	32
1980	18.00	18
1990	21.00	21
Totals =	184.69	155

Watershed - 24

Decade	Acres	No.of Fires
1940	18.00	18
1950	18.00	18
1960	87.79	37
1970	39.00	39
1980	50.53	23
1990	64.73	60
Totals =	278.05	195

Human Occurrence by Decade and Watershed:

Watershed - 17

Decade	Acres	No.of Fires
1940	20.48	7
1950	22.46	18
1960	42.51	42
1970	47.00	47
1980	279.26	12
1990	76.38	4
Totals =	488.09	130

Watershed - 24

Decade	Acres	No.of Fires
1940	4.00	4
1950	11.00	11
1960	19.00	19
1970	61.00	61
1980	27.21	22
1990	17.00	17
Totals =	139.21	134

No attempt was made to associate Human caused fires by aspect or elevation. Total number of human caused fires equals 164 or 32% of all fires. The total number of acres burned by Humans equals 627.3 acres or 58% of all acres burned. Average size of human caused fire is 3.82 acres.

Total lightning and human caused fires equal 514. Total lightning and human burned acres equal 1091.04. The average size of all lightning and human cause fires is 2.12 acres. 54 total years of fires recorded equals 9.52 fires per year. 54 total years of fires recorded equals 20.20 average acres burned per year. Approximately 10 fires per year over a 54 year period have started which averaged approximately 2 acres.

The 1994 Westfir fire accounted for 75 of the 76.38 acres burned by humans so far this decade. The Westfir fire, and over 15 acres in the 1940's, were associated with the railroad. The Memorial Day Fires and the Silver Steer Fire in the 1980's accounted for nearly 300 acres burnt in that decade. These fires all occurred in Watershed 17. When these acres are deducted from total acres in Watershed 17, human caused acreage burned drops to 98, or an average of 0.75 acres per fire. This number is more indicative of visitor caused occurrence as Watershed 24 numbers show. It should also be noted that Fire Management direction in the 1970's emphasized foot patrols and reporting of abandoned campfires, particularly in Watershed 24 within the Waldo Lake basin. The extremely high number of fires was influenced by those efforts. Prior to and since that period, abandoned campfires that did not escape from the fire ring were not reported as statistical fires. However, this number is probably more representative of the human attitudes toward campfires.

The following specifics were extracted from the information given above:

- 92% of all fires have been above 3000 feet in elevation.
- 63% of total acres were on NW clockwise to E facing aspects, totaling 56% of all fires.
- 57% of all fires were above 4500 feet in elevation and accounted for 94% of all acres burned.
- 57% of all fires were in Watershed 24 and accounted for 66% of total acres burned.

Adding lightning and human caused fires and acres together, in addition to treated harvested acres since 1940, results in the following for Watershed 17:

- 28768 acres burned (32%)
- 89% of total harvested acres that were not treated are in this area.
- An average of 300+ burned per decade or approximately 3000 acres per century. These were stand replacement fires and accounted for roughly 25% of the area that naturally burned since 1770.

Timber harvest has kept the percentages of fuel models 8 and 10 approximately balanced between each other which normally was not the case prior to timber harvest. Due to small patch harvesting practices the heat generated by a fire start in uncut natural stands, in addition to the approximately 18,000 acres of untreated harvested acres and approximately 10,300 acres of harvested units determined to be FM10, very large stand replacement events could result during dry weather conditions. Harvested areas that were treated may act as buffers or areas where fire intensity would be greatly reduced, but would be at risk of also being destroyed. Harvesting of timber may have been timely to duplicate large fire return interval by removing timber rather than allowing it to be destroyed by fire, but the method of cutting and fuel treatment in no way duplicates fire history. The patches of remaining late-successional and old-growth stands become significant given this sequence of events due to the fact that as they become older, fuel loadings will increase. This will increase their vulnerability to fire. If it is important to maintain diversity in these areas, fire suppression efforts become very critical. In this case access, fuel breaks, and quick response ability must be maintained rather than just reducing fuels since fuels reduction could change the desired conditions of these seral stages. Protection of younger stands is vital to bring this area back to an older seral stage. 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.

Adding lightning and human caused fires and acres together, in addition to treated harvested acres since 1940, results in the following for Watershed 24:

- 2,165 acres burned (7%)
- 11% of total harvested acres that were not treated are in this area.
- An average of 22,000+ acres burned per decade or approximately 75% of the area that naturally burned since 1770.

Areas most vulnerable to fires are those stands comprising old growth (39% of the area) of which 26% are categorized as FM10. James Agee states in "Fire Effects on Pacific Northwest Forest: Flora, Fuels, and Fauna" (1981), "The impact of effective fire control in western hemlock/Douglas-fir type has not been nearly as significant as in forest types where fire was frequent. Suppression has been effective for only a fraction of a normal fire return interval in this type."

For the total watershed:

- 11,8702 acres of the watershed has burned or has been harvested and treated since 1770 (75%).
- Roughly 40,000 acres have not burned. We know that some of this area received a light understory burn at some time.

WILDLIFE

TERRESTRIAL WILDLIFE HABITAT

Reference Conditions

A historical representation of what was thought to be the pattern of seral stages on the watershed landscape is provided in Figure 18 of this chapter. This can be compared to the current pattern of seral stages presented in Figure 19 of this chapter.

As described in the Fire History section of the Characterization (Chapter II), portions of the watershed were exposed to a series of extensive (probably over lapping) stand replacement fires. The majority of Watershed 24 was burned within the past 200 years. In Watershed 17 however, fires within the past 200 years have been in relatively small patches and relatively much less frequent.

It is anticipated that stands within Watershed 17 may have been exposed to stand replacing fires relatively less frequently than stands in Watershed 24, thus may have been more likely to develop into large tracts of old-growth forests. Stands within Watershed 24, being exposed to more frequent stand replacing fires, may have included relatively more extensive tracts of mid and late seral forests between major fire events, with relatively small patches of old-growth developing mainly in sheltered areas such as basins, valley bottoms and patches associated with topographic breaks.

Edge Habitat

The species guilds include those groups of species with various home range sizes that prefer specific types and arrangements of habitat. Appendix A, Table 1, provides a list of species and their guilds. The contrast guilds include those species that prefer distinct edges between open areas (or early seral stands) and late seral or old-growth forests.

Natural edges are formed where forested plant associations meet non-forested areas such as meadows, talus slopes or rock gardens. Transitional edges also occur where stand replacing fires (early seral) adjoin underburned or unburned patches (late seral) within fire areas. Some fires are relatively small, have irregular edges or have varying levels of crown mortality. Within those areas contrast habitat is abundant, and so long as appropriate habitat for reproduction and feeding are both present, populations of contrast species are expected to have responded favorably to patchy or variable wildfires. Other areas within the watershed that did not host frequent patchy fires would have had contrast habitat mainly in association with non-forested inclusions in forested stands or along the edges of large natural openings. Appendix A (Figures 1 through 3) presents maps of approximate historic (1920) contrast habitat. The map of large home range contrast (TLC) guild habitat (Figure 22 of this chapter) displays the largest tracts of fire mosaics with early seral components in the early 1900's as well as the larger natural meadow complexes.

Aggregations of fire patches also provide short term benefits to species that use aggregated patches of early seral habitat (early seral mosaic guilds) and species that use combinations of early and mid seral habitat (generalist for early and mid seral guilds). Appendix A (Figures 4 through 7) contains maps of early seral patch and mosaic guilds thought to be present in a historic (1920) landscape. The map of large home range mosaic early seral (TLME) guild habitat is displayed in Figure 23 of this chapter.

As coniferous regeneration becomes established in areas that have not been recently burned over, landscapes lose the contrast habitat. Fire regenerated stands transition to closed canopy sapling and pole stands. At this point in development the habitat becomes best suited for generalist guild species (those species that use a combination of various habitat types). As these fire stands mature, they provide habitat for mid- and late-seral guilds.

In the historic landscape, elk habitat in Watershed 17 was likely limited by forage areas. Effective forage areas would have included natural openings and the recently burned patches. On Watershed 24, elk habitat was likely not limited by forage due to fire frequency, abundance of natural openings, and relatively slow coniferous cover development. The interspersion of effective cover in large burned over areas, may have resulted in temporary limitations within portions of that watershed. Road density was not an issue in the historic landscape.

Interior Forest Habitat

Natural patterns of disturbance often involved large sections of the landscape. As these stands regenerated and developed into mature stands, suitable habitat for large and medium home range species in the late-seral mosaic, late-seral patch and generalist for mid- and late-seral guilds was provided (see Appendix A , Figures 8 through 10). Figure 24 of this chapter displays a potential historic (1920) map for terrestrial large home range mosaic late seral (TLML) guild habitat. This map depicts the areas within the watershed that provided the highest amounts of the largest patches of late-seral and old-growth habitat.

Habitat Structure

The amount of large woody debris and snag habitat in the historic landscape would have varied within the watershed. In some areas reburning of previously burned areas tended to remove many of the snags and logs that remained after the original fire. Repeated burning tends to lower the amount of snags and down wood on the forest floor, particularly on steep south and west facing slopes. Large wood typically would have been retained at higher levels within riparian and aquatic habitats. In other fire areas reburning did not occur and natural levels of snags and logs are abundant.

Connectivity and Dispersal

Connectivity of habitat on the landscape varies with historic fire intensity and extent, however, riparian areas typically served as the key connectors between unburned or underburned patches within more fire prone areas. Later-seral habitats were contiguous and Watershed 17 from ridgelines to riparian zones in most areas. Figure 18 of this chapter displays a potential map of historic (1920) late-seral and old-growth forests.

Non-Native Species

No non-native species are known to have been present prior to European colonization.

Current Conditions

Edge Habitat

Portions of the watershed have become highly fragmented as a result of scattered setting timber harvest using regeneration harvest (commonly clearcut) methods within the past 4 decades. Within those areas contrast habitat is abundant, and so long as habitat for reproduction and feeding are both present, populations of contrast species are expected to have responded favorably to recent management activities. Other areas within the watershed have not been treated with scattered setting clearcuts, or have had minimum fragmentation timber management strategies applied. In these areas, contrast habitat may not be as prevalent as in the more fragmented sections of the watershed, unless numerous natural openings are interspersed among forested areas. Appendix A (Figures 11 through 13) presents maps of current contrast habitat. The map of large home range contrast (TLC) guild habitat (Figure 25 of this chapter) displays the largest tracts of highly fragmented habitat along with the larger forest/meadow complexes.

Forest fragmentation may also provide short term benefits to species that aggregate patches of early seral habitat (early seral mosaic guilds) and species that use combinations of early and mid seral habitat (generalist for early and mid seral guilds). Appendix A (Figures 14 through 17) contains maps of early seral patch and mosaic guilds. Refer to reference condition for large home range mosaic early seral (TLME) guild map (Figure 26 of this chapter).

Areas within the watershed that have not recently experienced regeneration harvest or wildfire have lost the contrast habitat as harvested areas transition in to closed canopy sapling and pole stands. At this point in development the habitat is best suited for generalist guild species (those species that use a combination of various habitat types). Although minimum fragmentation harvest strategies do not create as much edge habitat for contrast species, they do provide suitable habitat for many generalist guilds, and may promote medium and large home range mosaic and generalist habitats in the long term.

Elk are considered to be large home range, contrast species. They foraging primarily in open areas and seek shelter in late-seral or old-growth forests. Elk habitat capability is generally enhanced by scattered setting regeneration harvests (forest fragmentation), up to a point. When cover becomes limiting and edge habitat decreases through continued cover removal in heavily harvested areas, elk habitat capability declines. The current condition of elk habitat within the watershed varies with harvest

Figure: 22a

Historic

Terrestrial, Large Home Range

Contrast Species.

Lower North Fork Middle Fork

Willamette River Watershed

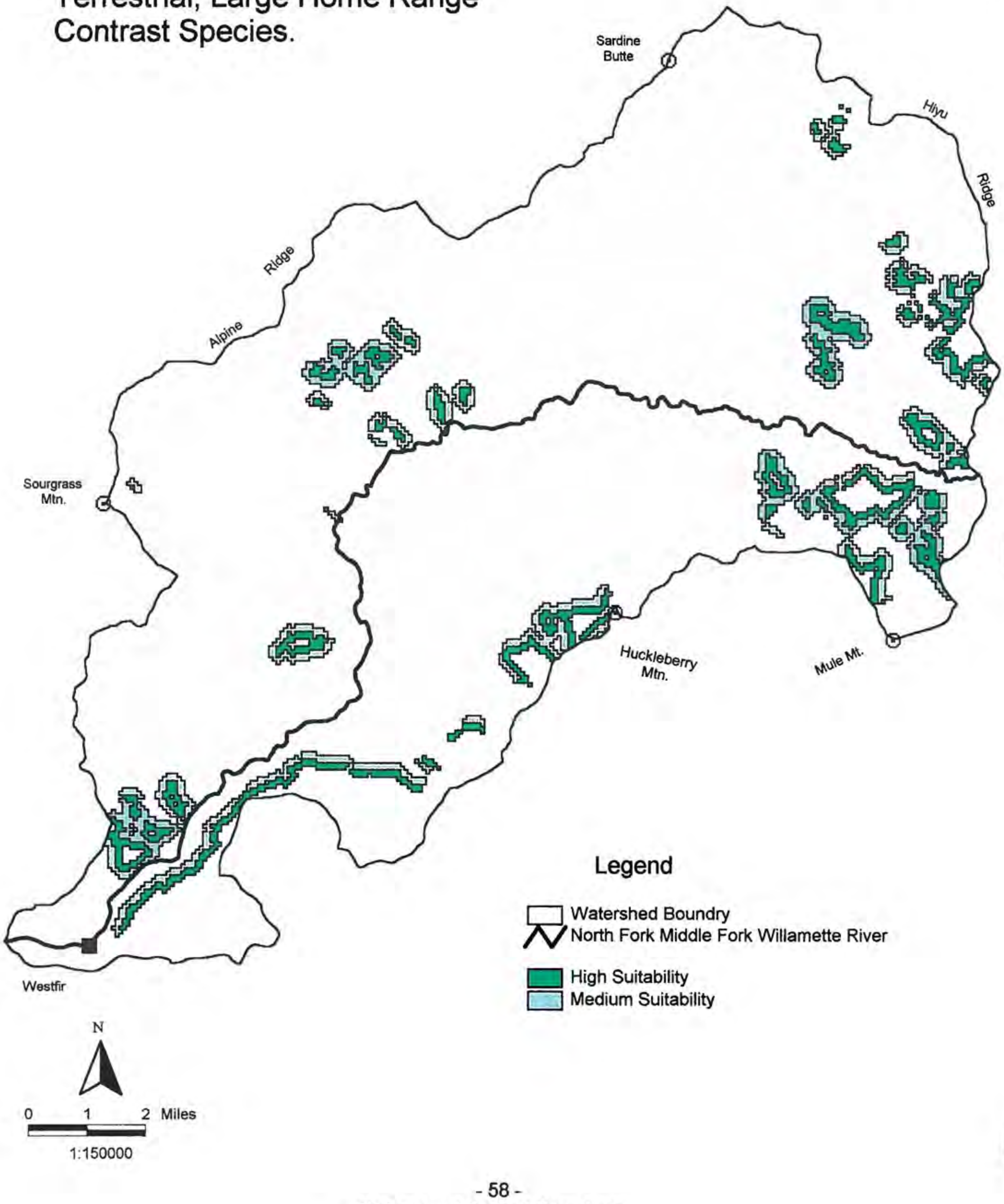


Figure: 22b

Historic
Terrestrial Large Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

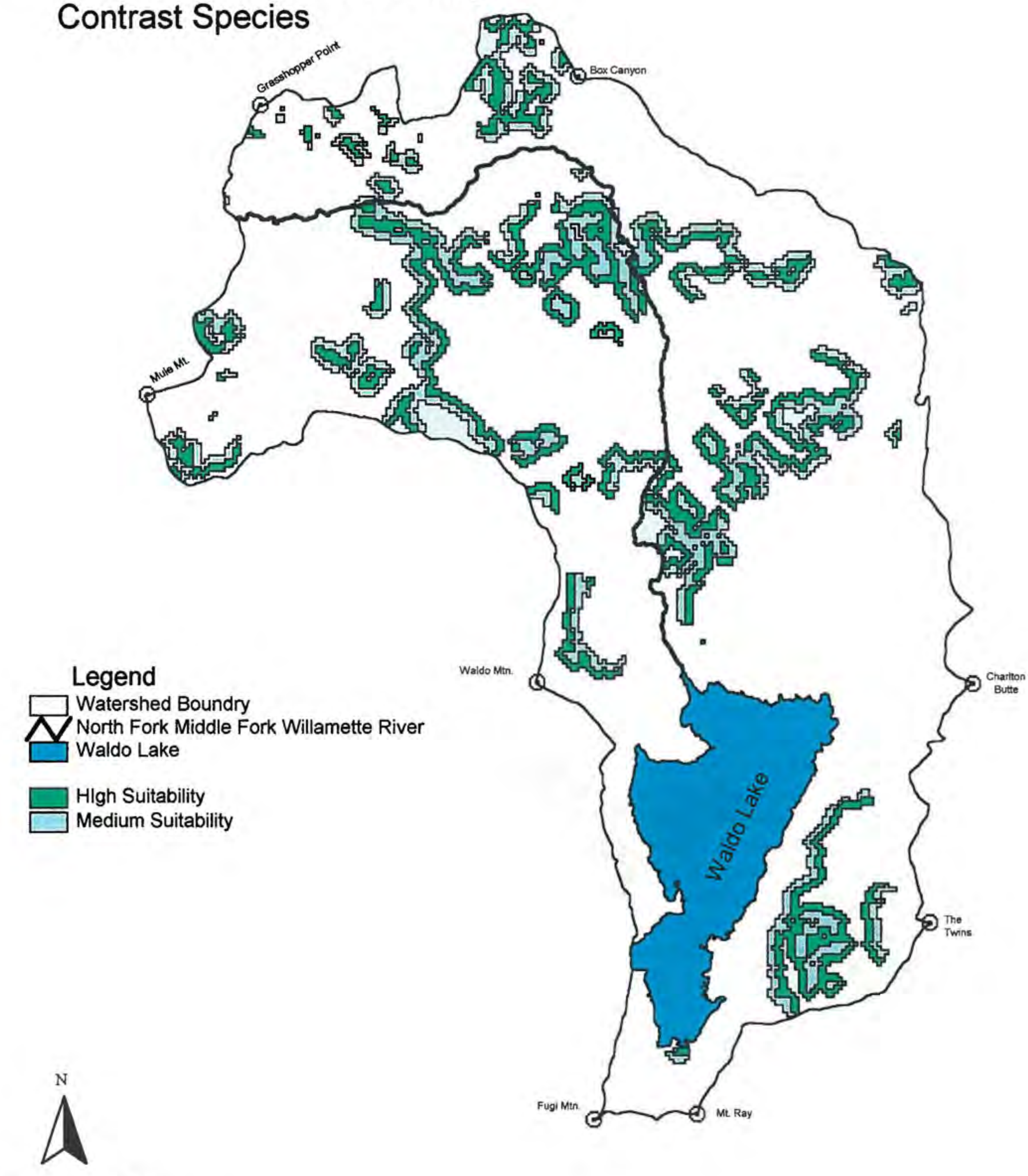


Figure: 23a
Historic
Terrestrial, Large Home Range,
Mosaic, Early Seral

Lower North Fork Middle Fork Willamette River Watershed

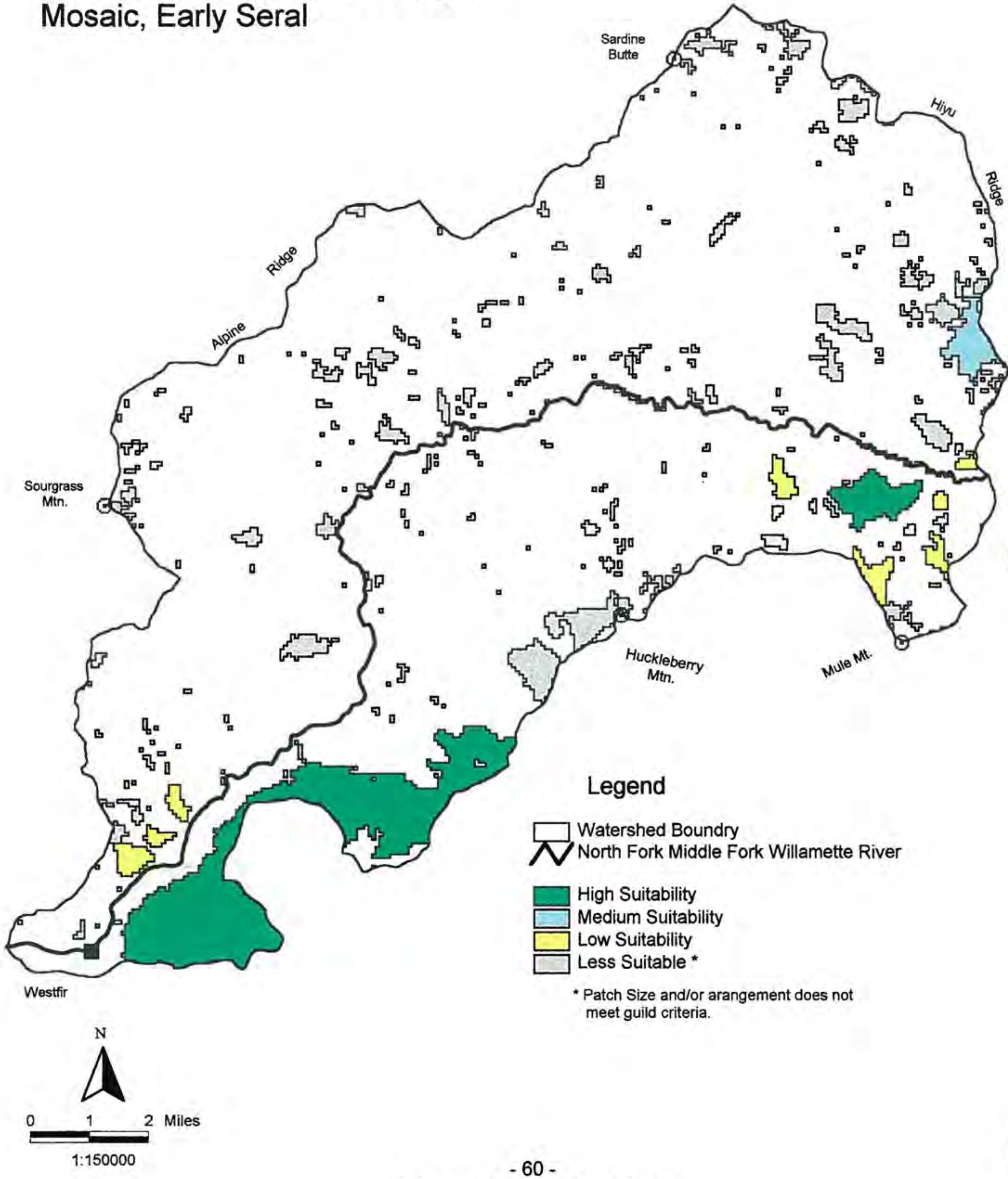


Figure: 23b
Historic
Terrestrial, Large Home Range
Mosaic, Early Seral

Upper North Fork Middle Fork
Willamette River Watershed

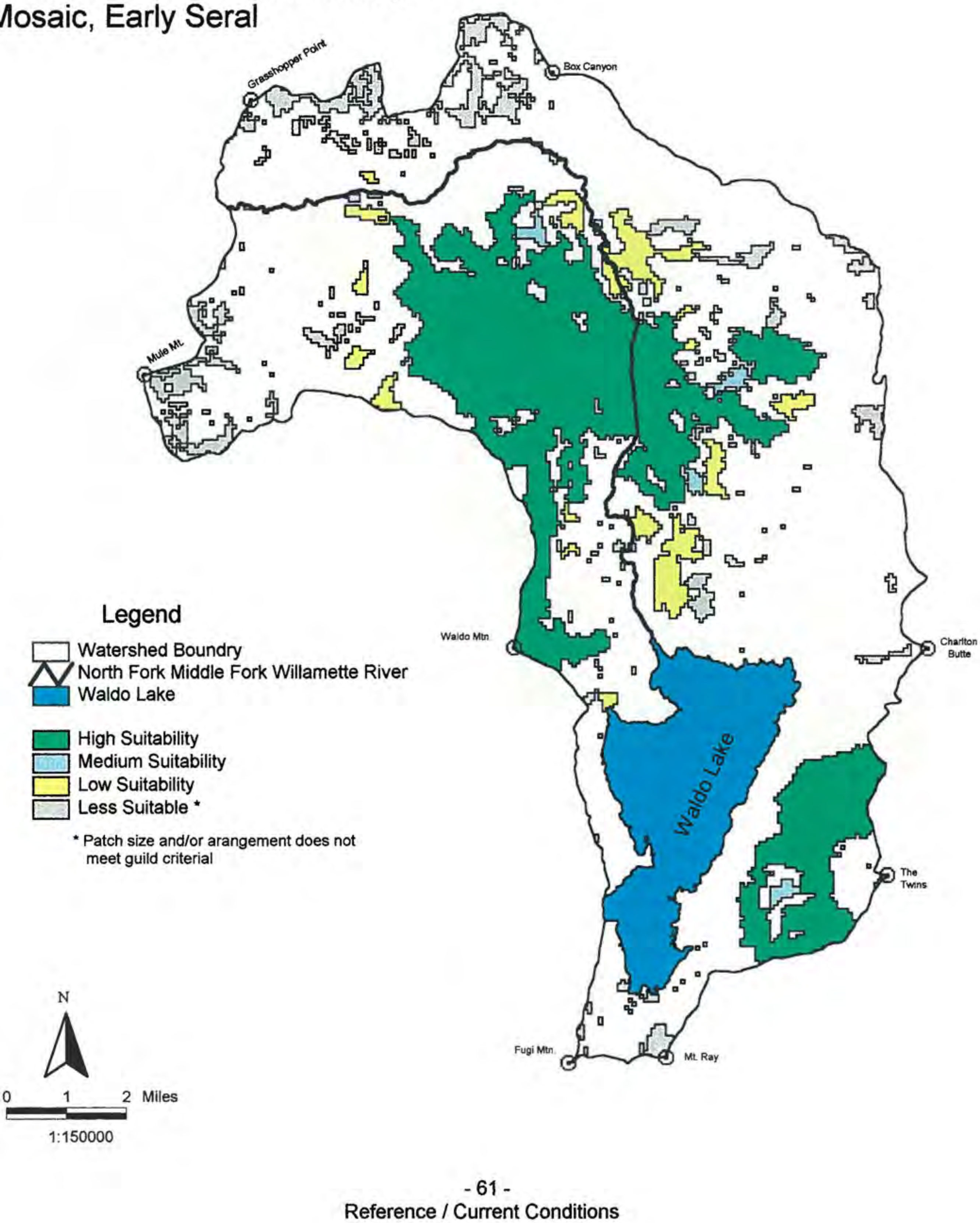


Figure: 24a

Historic
Terrestrial, Large Home Range,
Mosaic, Late Seral

Lower North Fork Middle Fork
Willamette River Watershed

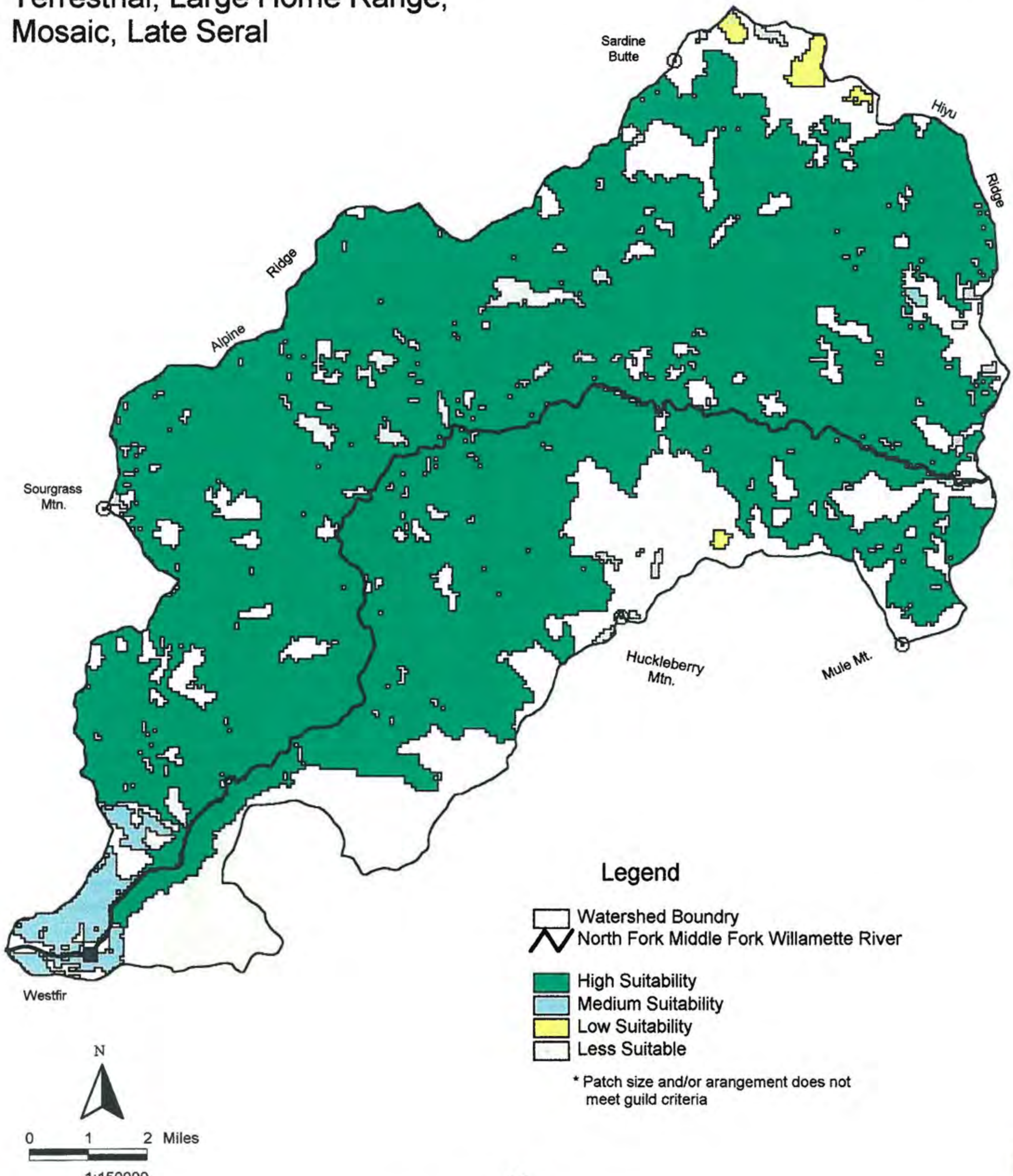


Figure: 24b
Historic
Terrestrial, Large Home Range,
Mosaic, Late Seral

Upper North Fork Middle Fork
Willamette River Watershed

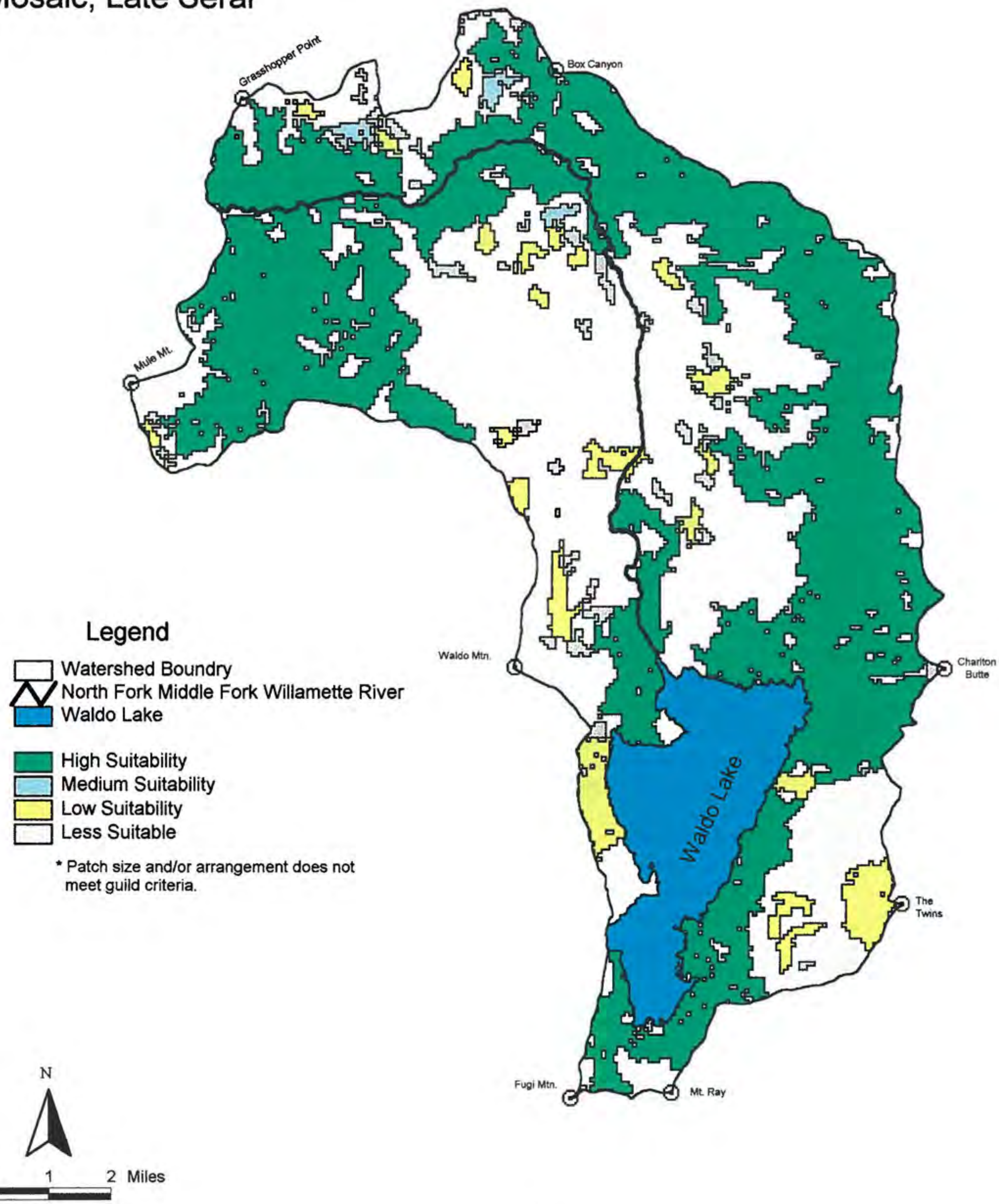


Figure: 25a

Current
Terrestrial Large Home Range
Contrast Species

Lower North Fork Middle Fork
Willamette River Watershed

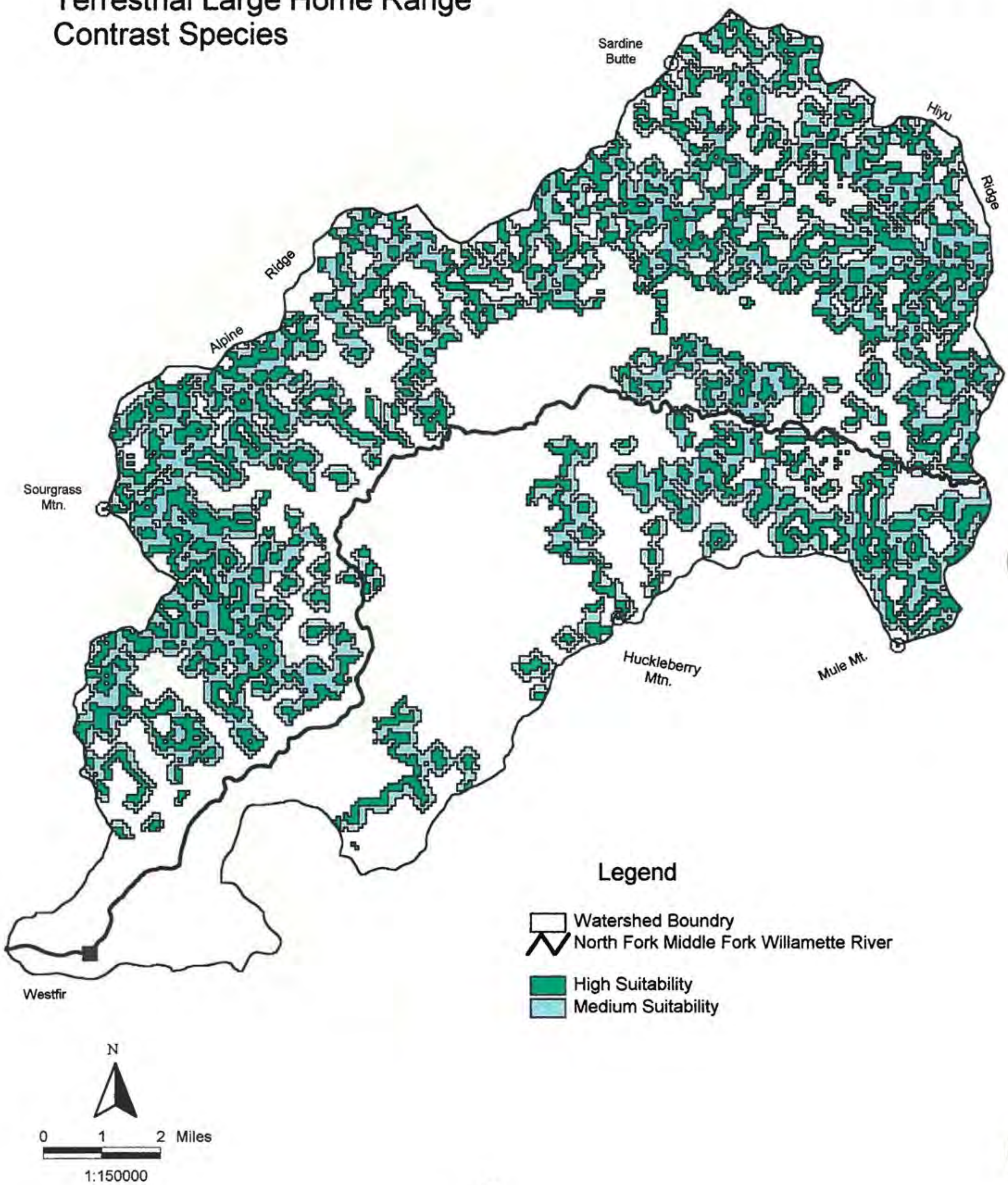


Figure: 25b

Current
Terrestrial Large Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

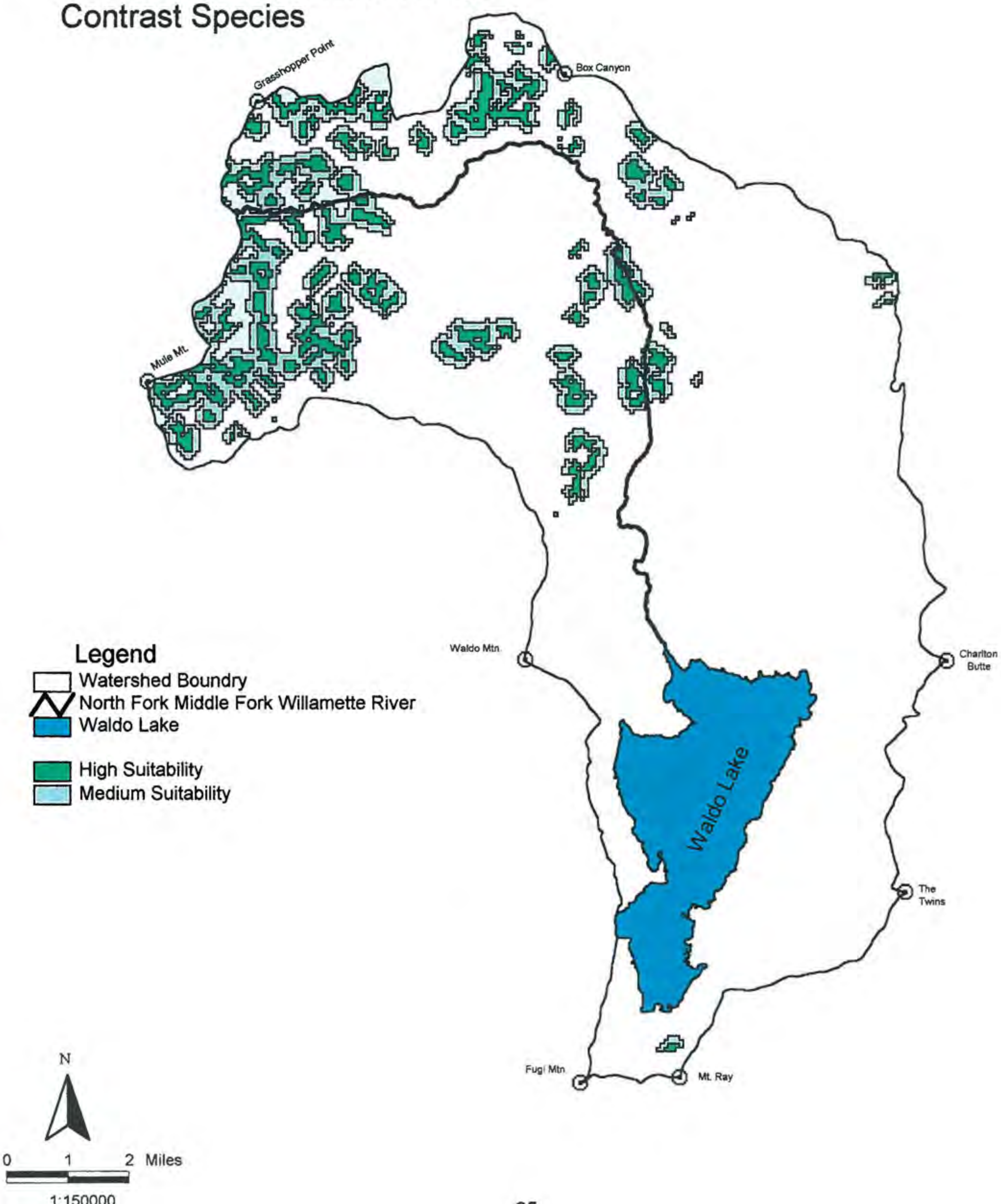


Figure: 26a
Current
Terrestrial, Large Home Range,
Mosaic, Early Seral

Lower North Fork Middle Fork
Willamette River Watershed

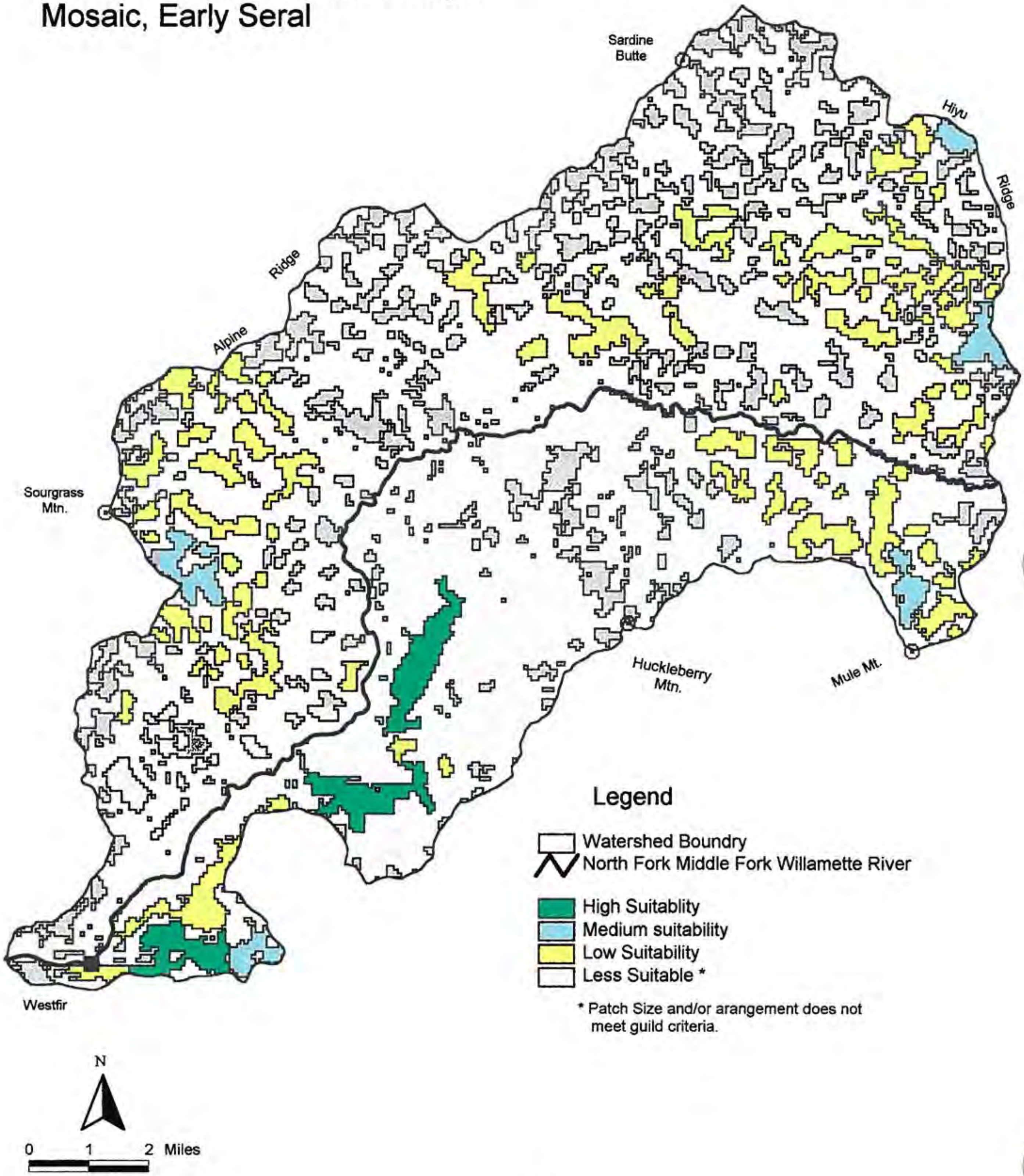


Figure: 26b
Current
Terrestrial, Large Home Range
Mosaic, Early Seral

Upper North Fork Middle Fork
Willamette River Watershed

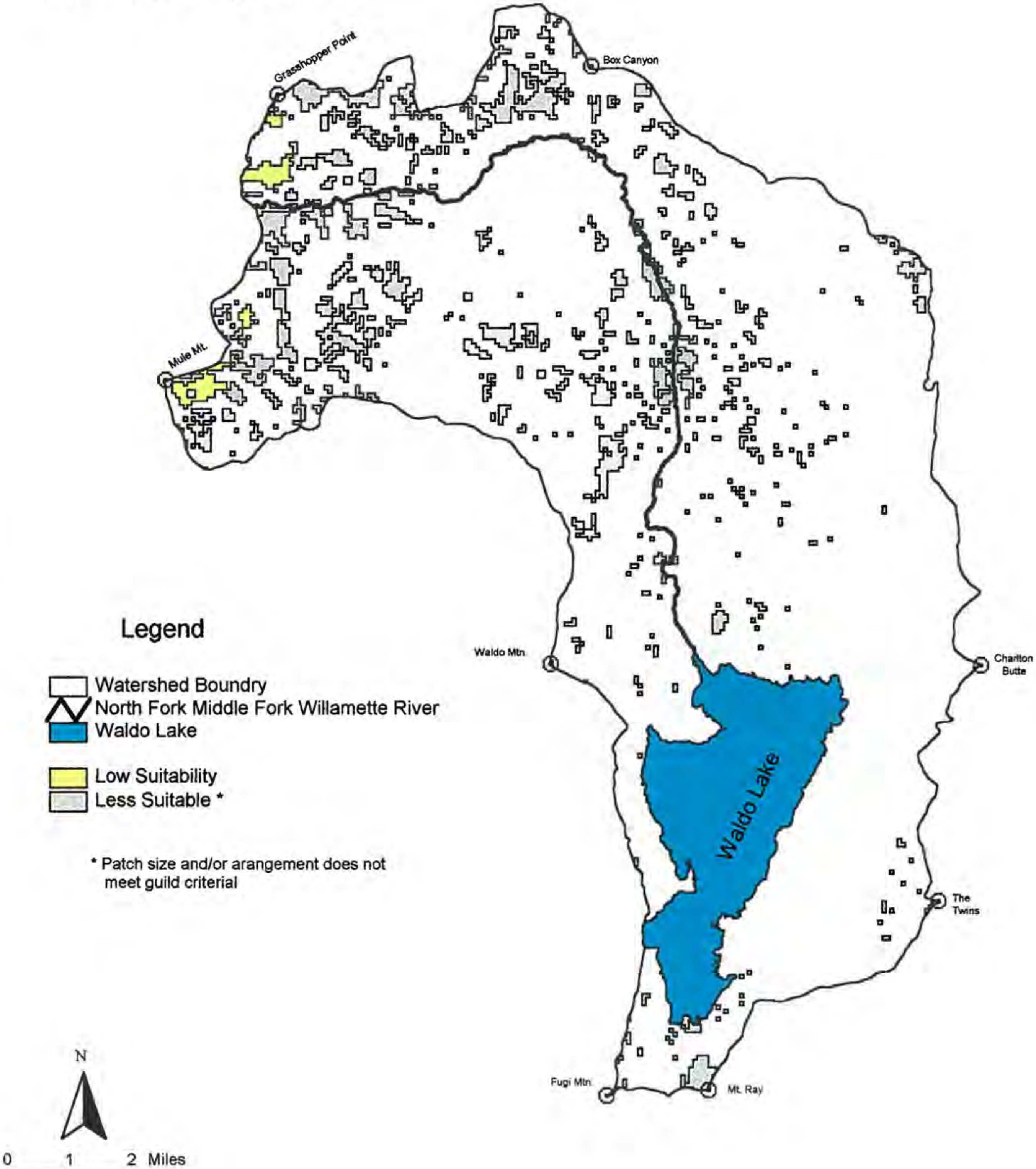


Figure: 27a

Current

Terrestrial, Large Home Range, Mosaic, Late Seral

Lower North Fork Middle Fork Willamette River Watershed

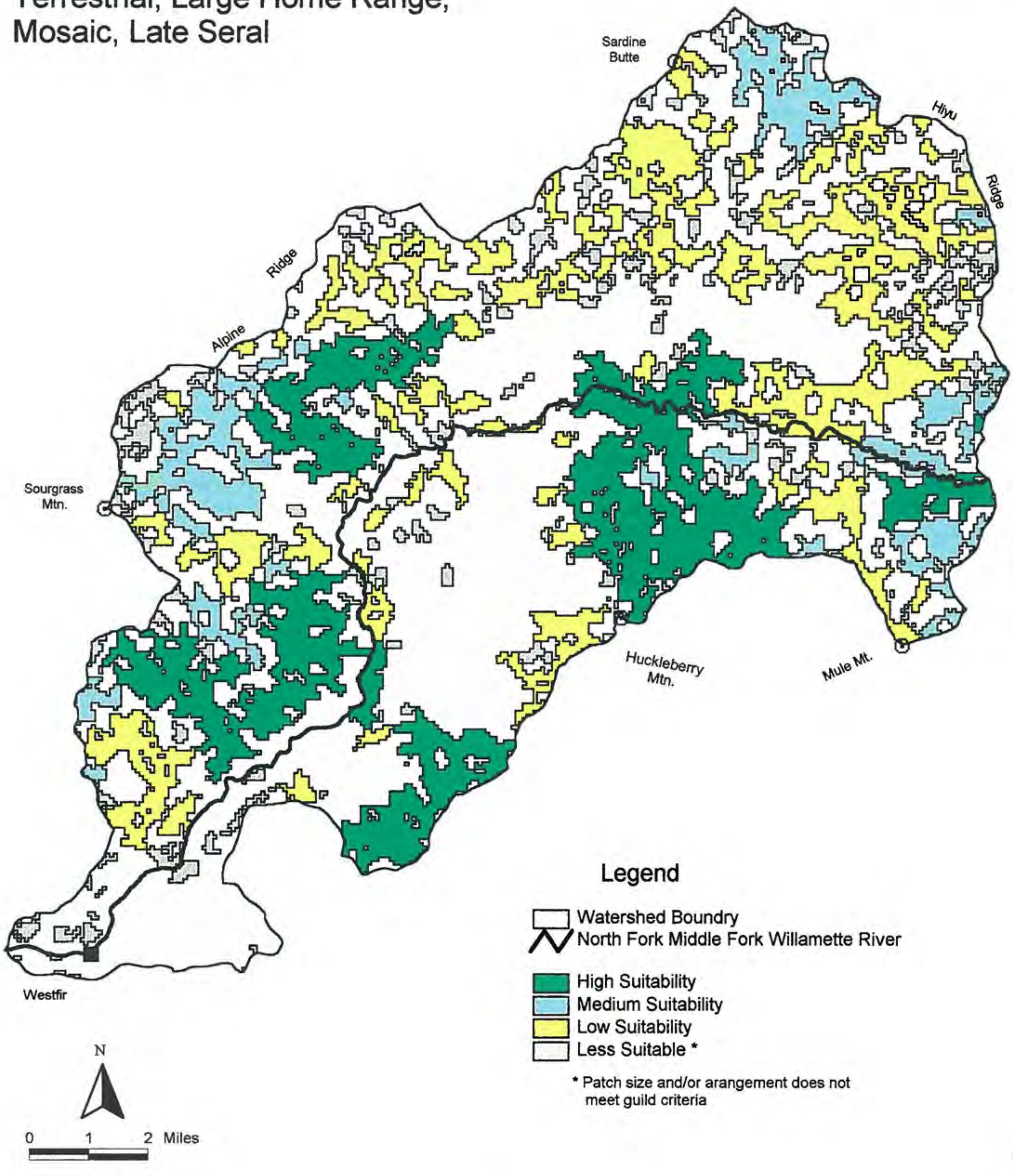
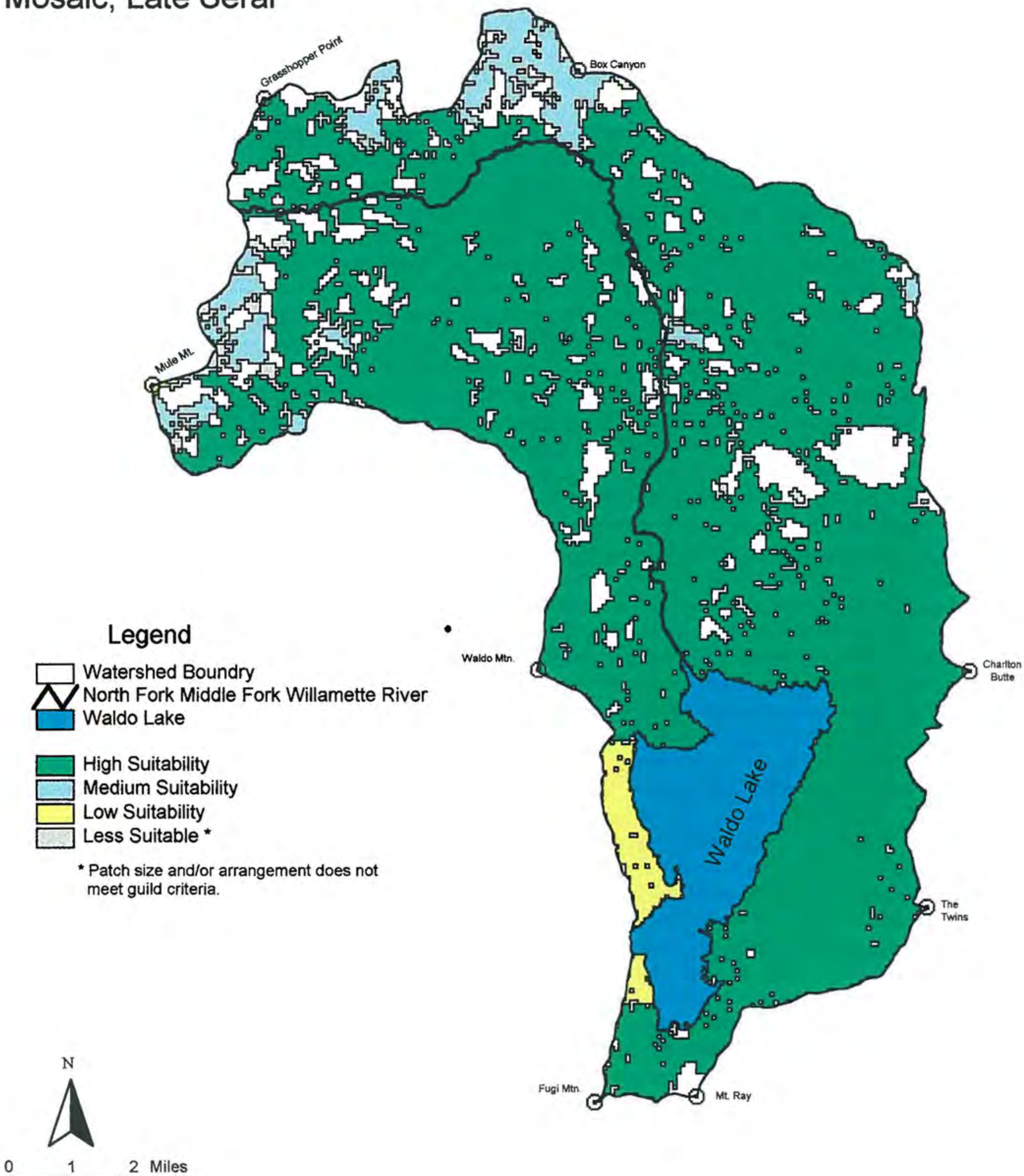


Figure: 27b

Current

Terrestrial, Large Home Range, Mosaic, Late Seral

Upper North Fork Middle Fork Willamette River Watershed



and road building history as well as naturally occurring features such as meadows and other non-forested areas. Habitat effectiveness may also have been altered by fire suppression which may have changed the abundance and arrangement of natural foraging areas.

The current Habitat Effectiveness Indices for the 19 Elk Emphasis Areas are summarized in Table 22 of this chapter.

Interior Forest Habitat

Forest fragmentation, as described above, tends to reduce the suitability of habitat for large and medium home range species in the late-seral mosaic, late-seral patch and generalist for mid and late-seral guilds (Appendix A, Figures 18 through 20). Minimum fragmentation strategies tend to retain habitat suitability for these guilds in the areas where harvest is avoided, but the habitat is removed in the harvested areas. Appendix A (Table 1) contains a list of which species belong to which guilds.

Table 22: Current Elk Habitat Effectiveness

		Individual Indices				Overall Index
BGEA	Emphasis	HEs	HEr	HEc	HEf	HEI
Captain	Moderate	0.61	0.50	0.39	0.40	0.47
Chalk	Low	0.77	0.54	0.69	0.50	0.62
Christy South	Moderate	0.78	0.42	0.58	0.43	0.53
Eddeeleo	Moderate	0.44	1.00	0.66	0.32	0.55
First	Low	0.64	0.51	0.52	0.54	0.55
Fisher West	Moderate	0.61	0.84	0.68	0.37	0.60
Grasshopper	Moderate	0.77	0.71	0.66	0.47	0.64
Hammer	Low	0.79	0.54	0.73	0.51	0.63
High Flat	Low	0.66	0.51	0.50	0.65	0.58
Huckleberry	Moderate	0.67	0.36	0.44	0.49	0.47
Lowell	Moderate	0.86	0.53	0.63	0.51	0.62
Major-Parker	Low	0.82	0.33	0.53	0.50	0.52
Moolack Lake	Moderate	0.57	1.00	0.66	0.29	0.57
Mossy-Grassy	High	0.70	0.53	0.66	0.48	0.59
Nehi	Moderate	0.84	0.49	0.56	0.50	0.58
Short-Hemlock	Low	0.67	0.53	0.68	0.47	0.58
Pothole	Moderate	0.33	0.88	0.79	0.30	0.51
Skookum	High	0.61	0.73	0.63	0.39	0.58
Waldo	Moderate	0.31	0.82	0.83	0.44	0.55

Emphasis Ratings: (from Willamette National Forest Land Management Plan)

Standards & Guidelines - High from S&G FW-148, Moderate from S&G FW-151, and Low from S&G FW-153)

Individual Index: High > 0.5
Moderate > 0.4
Low > 0.2

Overall Index: High > 0.6
Moderate > 0.5
Low: increase if any variable is below 0.2

Index Definitions:
HEs - size & spacing HEr - road density HEc - cover quality
HEf - forage quality HEI - overall

Northern spotted owls are representative of species that select for late-seral and old-growth interior forest habitat. Spotted owls are considered to be within the large home range mosaic late-seral guild (TLML). Figure 27 of this chapter displays a map for this guild. That map depicts the areas within the watershed that provide the highest amounts of the largest patches of late-seral and old-growth habitat within approximate home ranges (about 3000 acres) for this species. However, the map does not distinguish plant associations (vegetative communities), thus not all of the area mapped in Watershed 24 would be suitable for Northern Spotted Owls. Late seral true-fir and Mountain Hemlock are better utilized by Marten, and Black-backed and three-toed Woodpeckers.

A commonly accepted way to assess habitat conditions for northern spotted owls is to describe the conditions of the individual home ranges for each habitat activity center (HAC). The amount of habitat within an average size home range for the Oregon Cascades Province (1.2 mile radius or approximately 2900 acres) should be above 40% of the area within the home range in order to maintain reproductive viability of the site. The current amounts of suitable habitat within the provincial radius of known spotted owl sites within the watershed is displayed in Table 23 of this chapter.

Table 23: Current Spotted Owl Home Range Conditions (Acres of Suitable Habitat)

Watershed 17: (44 activity centers)

Owl MSN	0.7 Mile Habitat	1.2 Mile Habitat	LSR No.	Owl MSN	0.7 Mile Habitat	1.2 Mile Habitat	LSR No.
0629	433.22	1097.88	N.A.	2771	525.55	1351.35	R0220
0634	631.66	1710.03	N.A.	2772	705.29	1883.64	N.A.
0637	510.66	1460.39	N.A.	2776	670.44	1742.54	N.A.
1100	663.56	1515.56	N.A.	2777	559.70	1362.54	N.A.
1101	455.97	1599.67	R0219	2779	582.35	1599.19	N.A.
1102	624.29	1411.66	N.A.	2781	364.13	1272.38	N.A.
1103	437.25	979.45	N.A.	2783	482.49	1413.53	N.A.
1105	483.20	1167.37	N.A.	2788	454.88	1300.77	N.A.
1106	384.14	1079.11	N.A.	2791	467.19	1247.64	N.A.
1110	486.40	1409.00	N.A.	2798	679.67	1966.29	N.A.
1111	473.82	1334.77	N.A.	2799	598.91	1576.61	N.A.
1112	760.35	1790.79	N.A.	2801	560.55	1697.67	N.A.
1113	716.31	1925.63	N.A.	2804	598.45	1475.93	N.A.
1114	655.43	1748.50	N.A.	2807	432.00	928.50	R0219
1115	589.37	1601.00	N.A.	2808	357.08	933.52	R0219
1116	609.43	1725.89	N.A.	2815	343.64	1233.34	N.A.
1121	528.71	1431.49	N.A.	2817	424.19	1234.60	R0219
2738	591.30	1771.98	N.A.	2819	402.31	1266.09	N.A.
2739	679.81	1954.05	N.A.	3095	468.32	1435.32	N.A.
2740	729.58	1932.78	N.A.	3570	401.95	1128.25	N.A.
2743	651.44	1273.96	N.A.	3987	508.32	1558.06	N.A.
2770	663.38	1437.74	N.A.	9015	403.32	1038.03	N.A.

(Table 23 continued on next page)

Table 23 (continued): Current Spotted Owl Home Range Conditions (Acres of Suitable Habitat)

Watershed 24: (15 activity centers)

Owl MSN	0.7 Mile Habitat	1.2 Mile Habitat	LSR No.
1107	753.61	2025.07	N.A.
1108	916.69	2507.10	N.A.
1123	761.10	2208.28	R0220
1124	422.57	1221.88	R0220
1127	613.67	1776.62	R0220
1128	693.05	1889.07	R0220
1153	483.51	1264.58	N.A.
2431	331.15	1044.94	N.A.

Owl MSN	0.7 Mile Habitat	1.2 Mile Habitat	LSR No.
2784	487.27	1350.00	N.A.
2789	833.43	2191.58	N.A.
2797	449.00	1245.15	R0220
2809	916.18	2514.39	N.A.
2823	528.21	1491.17	N.A.
3994	386.54	894.25	N.A.
4342	728.99	1876.07	N.A.

Key: MSN = Master Site Number
LSR = Late Successional Reserve
N.A. = Not Applicable (not in an LSR)

Habitat Structure

The amount of large woody debris and snag habitat is variable within the watershed. Some areas, particularly within several hundred feet of roads, and most areas with gentle topography, have been heavily salvaged. In some cases most of the snags have been removed and woody debris has been reduced both on the forest floor and within riparian and aquatic habitats. In other areas salvage has not occurred and natural levels of snags and logs are present. In managed stands large woody debris and snag level vary with the type of harvest and the time frame within which harvest occurred. Some of the older (pre 1950) harvested stands have trees that were retained as seed sources. These residual trees contribute to diversity within these otherwise young stands and ultimately provide a source for snag and large wood recruitment. Many of these older harvest units (logged prior to 1970) also have very large logs remaining from the original harvest, due to merchantability standards of the time. Later, utilization became an issue and slash treatment became standard practice between 1970 and 1989. Harvested areas were often left with little or no snags, large woody debris or residual trees big enough to offer recruitment for these habitat structures. As YUM (yard unmerchantable material) and PUM (pile unmerchantable material) requirements were abandoned and forest plan standards for snag and large woody debris retention were adopted (1990), the amount of wildlife tree and down log habitat began to increase. Table 24 of this chapter displays the acreage's within the watershed that were treated with intensive harvest treatments prior to 1970, from 1970 to 1989 and from 1990 to 1994.

Table 24: Acres of Intensive Harvest Treatment (stand replacement harvests)

Harvest Years	Acres
1969 and earlier	16,279
1970 through 1989	20,431
1990 to present	2,351
Total =	39,061

Connectivity and Dispersal

Connectivity of habitat on the landscape varies with previous or current management allocation. Areas that have been included as Spotted Owl Management Areas (SOMAs), later replaced by Spotted Owl Habitat Areas (SOHAs) and more recently Habitat Conservation Areas (HCAs) have a tendency to be relatively less fragmented and often have better connectivity that other areas within the commercial forest base. Areas within the wilderness, roadless areas and other relatively inaccessible areas have the highest level of connectivity. Areas that have been historically managed as general forest and even scenic Management Areas typically have lower levels of forest habitat connectivity. Figure 19 of this chapter displays a map of areas that are currently unharvested late-seral and old-growth forests. Figure 28 of this chapter displays currently unharvested areas within no-harvest allocations (including Riparian Reserves) as well as Riparian Reserves that have been previously harvested by harvest type.

Non-Native Species

No non-native species have become well established in this watershed.

AQUATIC WILDLIFE

FISH DISTRIBUTION

Reference Conditions

Historically, the North Fork contained, in addition to the various trout, char and other current native fish species, populations of spring Chinook salmon, steelhead trout, and bull trout (see distribution maps in Figures 29 through 32 of this chapter). Excellent runs of spring Chinook once utilized the North Fork and other tributaries to the Middle Fork (Salt Creek and Salmon Creek). Historically more spring Chinook salmon were produced in the North Fork of the Willamette River than in any other tributary of the Middle Fork of the Willamette. The North Fork once had spring Chinook runs of a magnitude comparable to the runs up the McKenzie drainage (Hutchinson et al., 1966). A 1938 survey of the North Fork commented that the North Fork from Christy creek to Brock Creek contained some of the finest spawning areas for spring Chinook salmon and steelhead in the entire Willamette River System (McIntosh et al.,1992). The Westfir dam blocked upward fish migration when it was installed in the early 1920's. The Westfir Dam was removed in 1994, but the migration of anadromous fish had been further blocked by the construction of Lookout and Dexter Dams in the 1950's on the Middle Fork of the Willamette River. Between 1957 and 1966 an average of 3,472 spring Chinook salmon and 223 steelhead trout were collected below Dexter Dam. (Hutchinson et al., 1966). This data shows that there was a sizable run of anadromous fish that were excluded from the tributaries to the Middle Fork of the Willamette due to dam construction. It is estimated that a total of 215 miles of stream historically accessible to salmon and steelhead were blocked by the construction of Dexter and Lookout Dams (this includes the North Fork, Salmon Creek, Salt Creek, Hills Creek, and the Upper Middle Fork of the Willamette) (Willamette Basin Task Force, 1969).

Current Conditions

To determine if there were any remnant populations of bull trout, the Upper North Fork, in the Cedar Bog area, was snorkeled in 1994. The habitat present in this portion of the North Fork is ideal for bull trout, yet no bull trout were observed. The presence of brook trout in this portion of the North Fork complicates any efforts to reintroduce bull trout to the North Fork system. Brook trout are known to hybridize with and to outcompete bull trout. Since the brook trout originate from a reproducing population in Waldo Lake and many other small lakes with outlet streams that are tributaries to the Upper North Fork, eradicating brook trout in the North Fork is an unlikely task.

Cutthroat and rainbow trout are common throughout the watershed. Rainbow trout exist lower in the watershed and cutthroat trout inhabit the upper portions. Population sizes of cutthroat trout populations are unknown. Although habitat has been altered through management activities such as timber harvest, road building and dams, it is not thought that cutthroat trout populations are threatened at this time although there is the potential for isolated populations above barriers such as culverts and

Figure: 28a

Connectivity Areas and Harvested Riparian Zones (110, 141, 143, 220)

Lower North Fork Middle Fork Willamette River Watershed

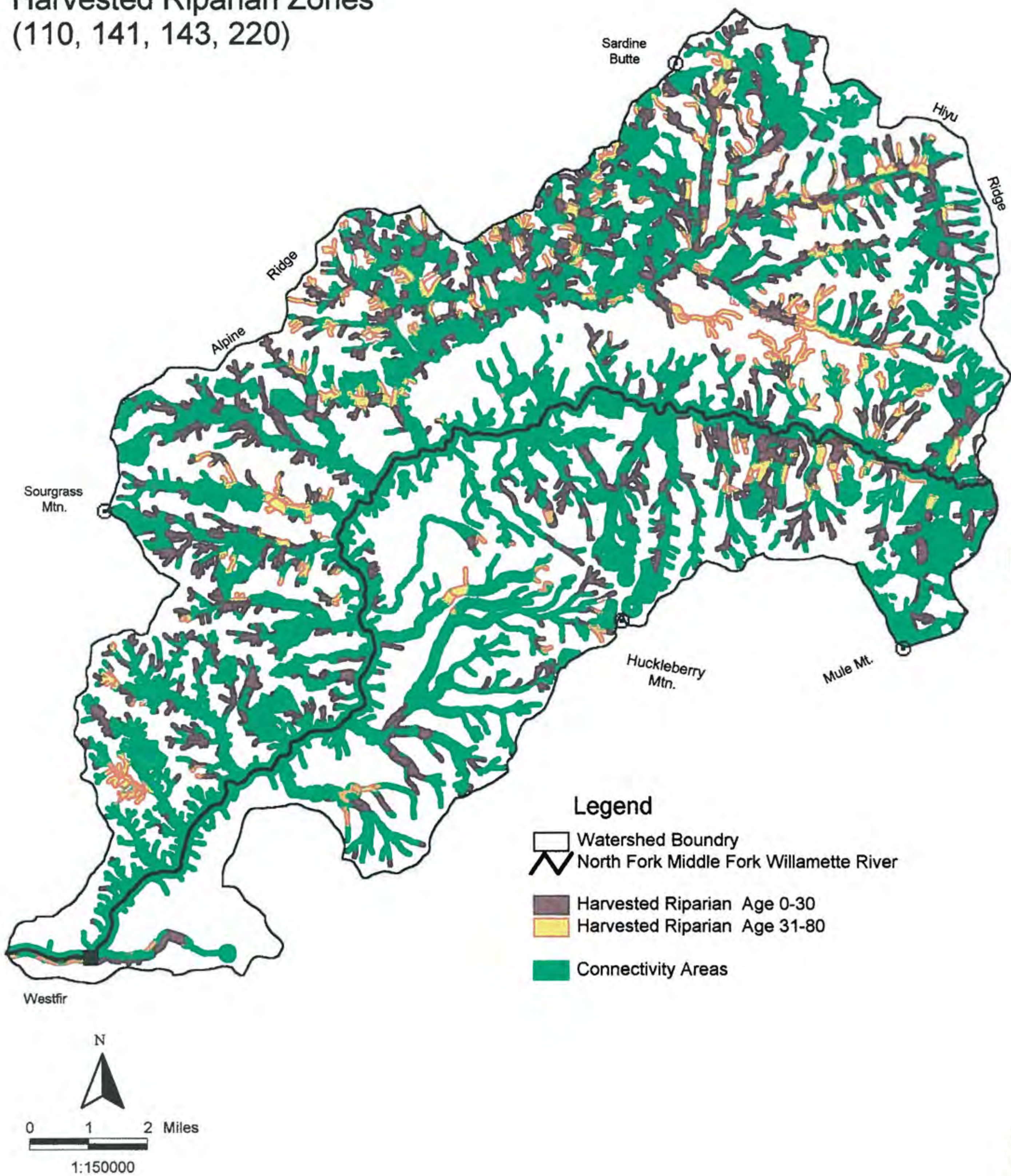


Figure: 28b
Connectivity Areas and Harvested Riparian Zones (110, 141, 143, 220)

Upper North Fork Middle Fork Willamette River Watershed

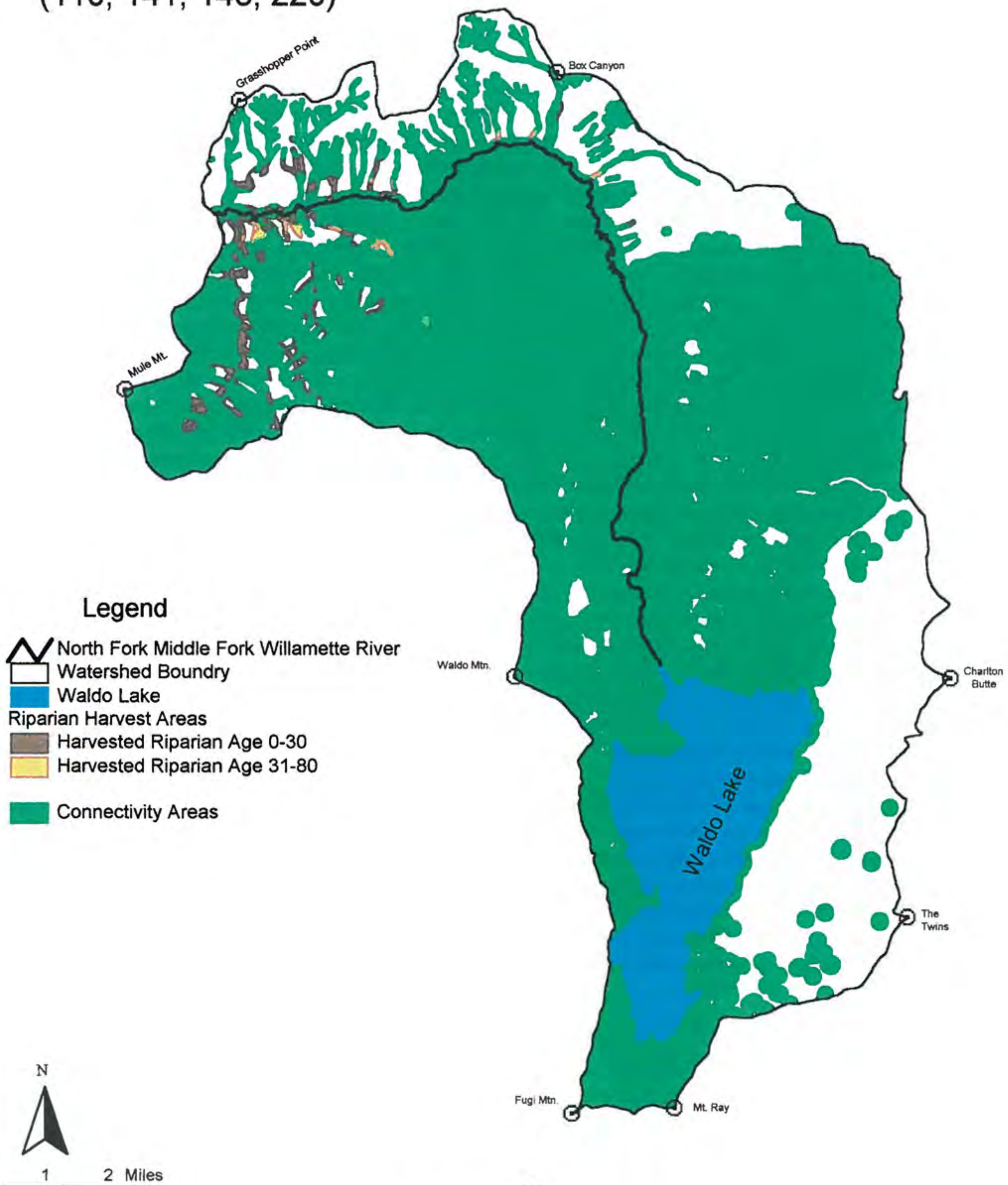


Figure: 29

Historic Distribution of Spring Chinook Salmon, Steelhead Trout and Bull Trout

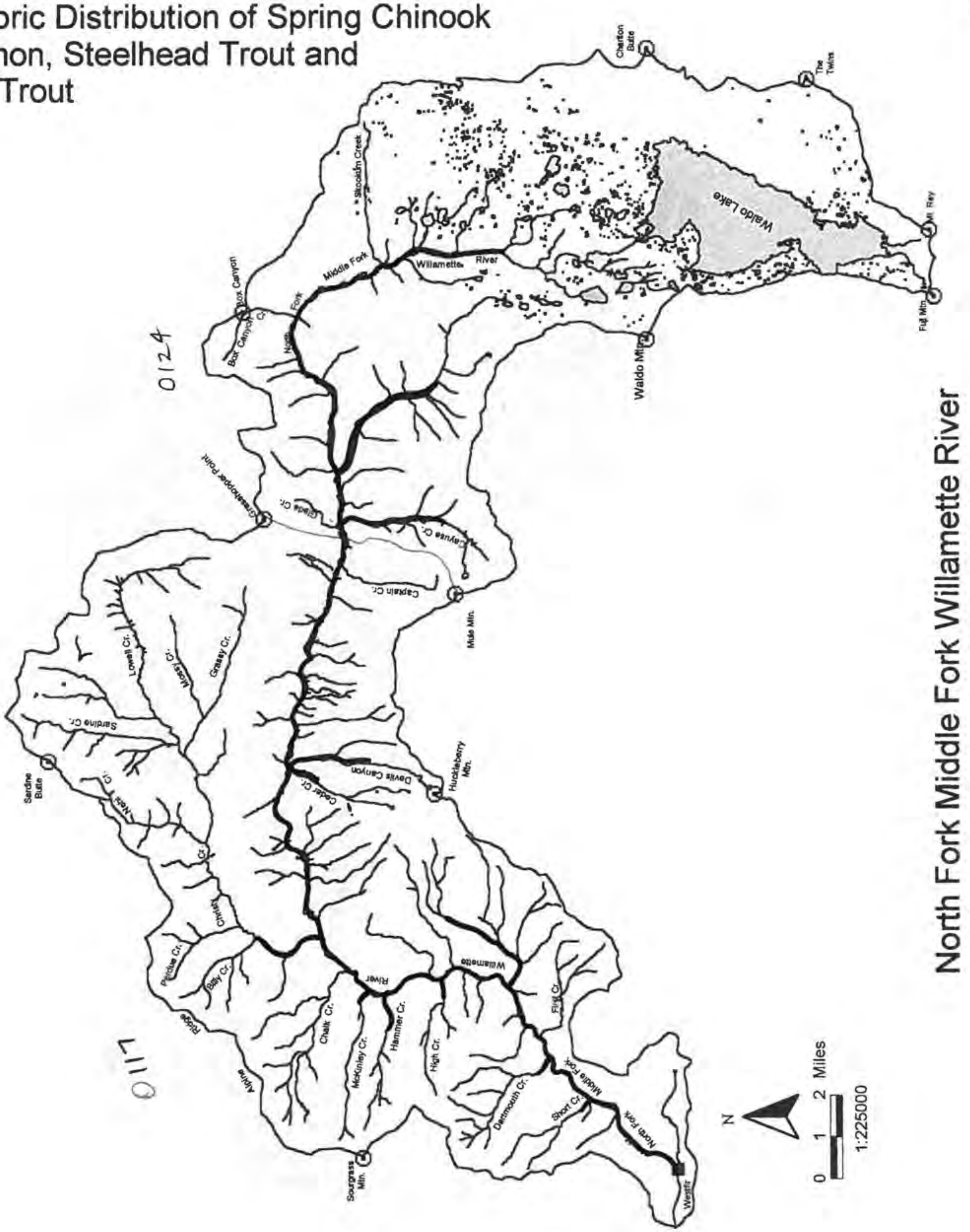
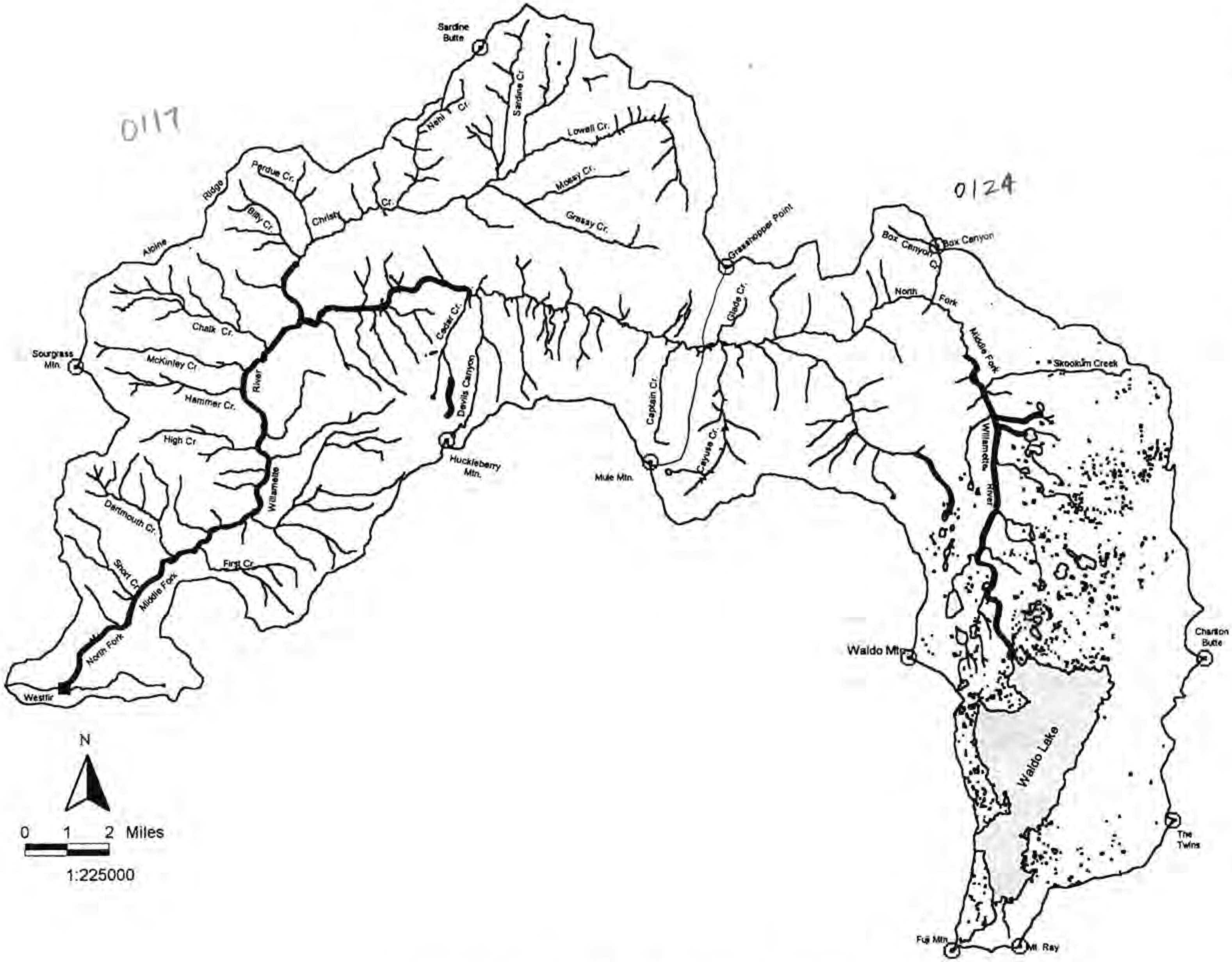
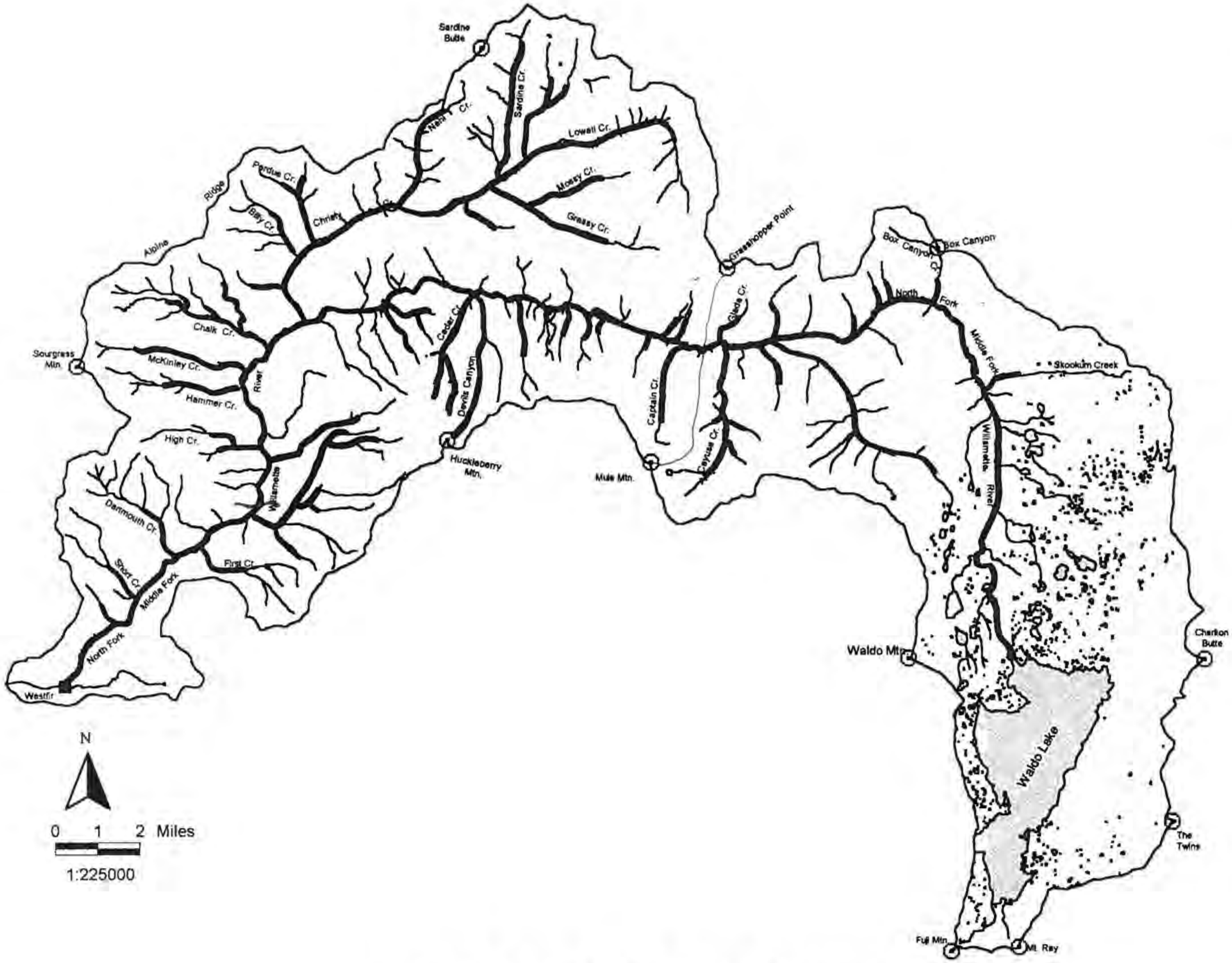


Figure: 30
Current Distribution of Rainbow Trout Populations



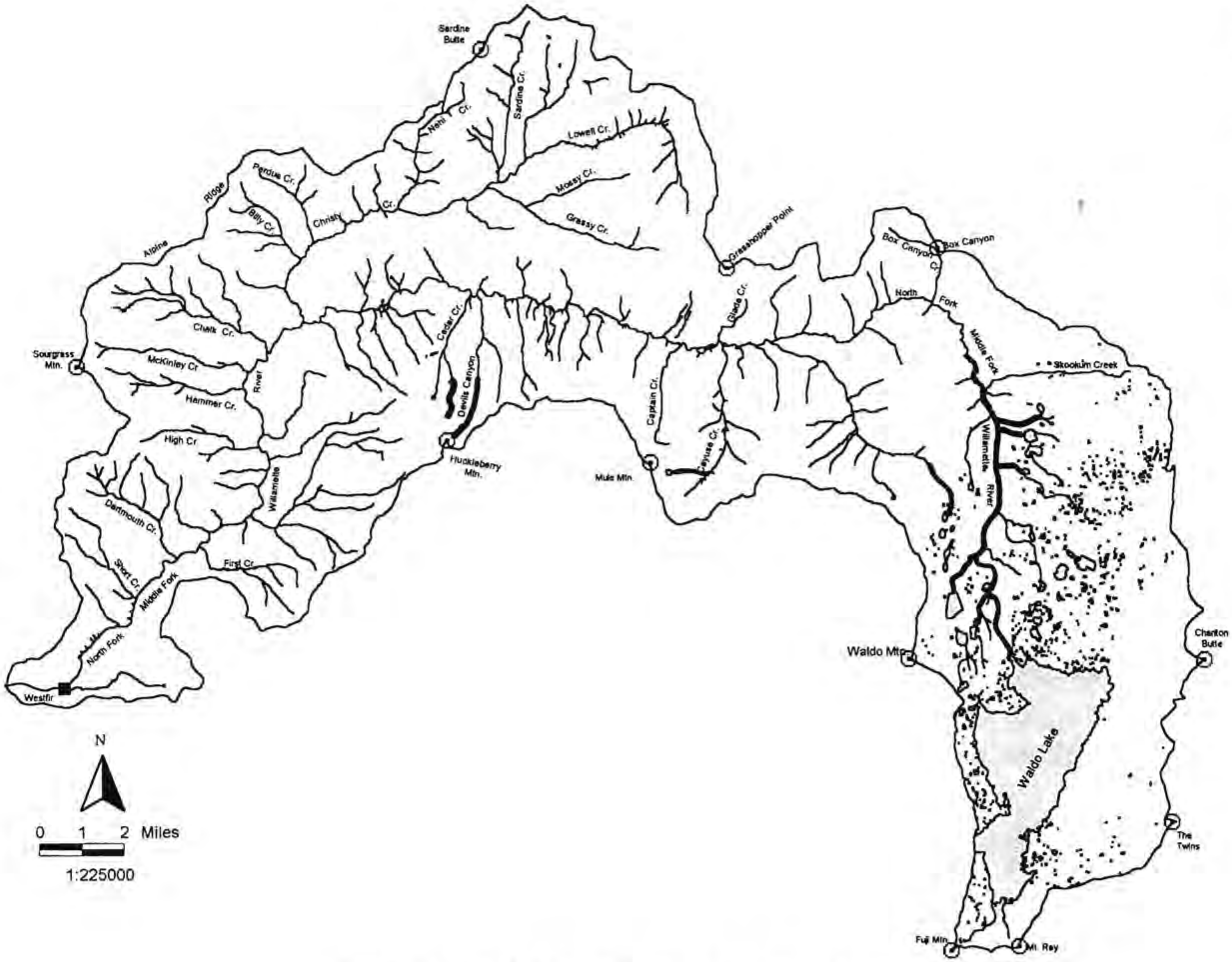
North Fork Middle Fork Willamette River

Figure: 31
Current Distribution of Cutthroat Trout Population



North Fork Middle Fork Willamette River

Figure: 32
Current Distribution of
Brook Trout Population



North Fork Middle Fork Willamette River

waterfalls to decrease in size and viability. Some cutthroat populations may be out of compliance with fish management policy due to unknown population sizes (Wade and Ziller, 1995). Rainbow trout populations are also thought to be in good condition at this time (Wade and Ziller, 1995). Brook trout are present in the extreme upper portions of the main stem North Fork as well as in tributaries that flow from lakes in which brook trout have been introduced. (See distribution maps, Figures 29 through 32 of this chapter)

Non-game fish species inhabiting the lower portions of the main stem North Fork and some of its tributaries include whitefish, large scaled suckers, squawfish, red sided shiners, and speckled dace (ODFW personal communication). Various species of sculpin are also known to inhabit the North Fork watershed.

Many lakes have been stocked with brook trout, rainbow trout and cutthroat trout. Some lakes contain naturally reproducing populations of trout while others are stocked regularly by ODFW. With the exception of Waldo Lake, little is known about the limnological and biological parameters of lakes within the watershed due to limited data collection.

Waldo Lake is a naturally fishless lake. Fish were first stocked by Judge John Beckenridge Waldo in the late 1800's. Files obtained from the Oregon Department of Fish and Wildlife (ODFW) report anglers catching Brook Trout as early as 1930 although ODFW has no records of stocking the lake until 1938. It is possible that other anglers followed the role of Judge Waldo and transported fish from nearby lakes to plant in Waldo Lake. This idea is supported by the capture of fish species such as brown trout and roach which were never officially stocked into Waldo Lake by ODFW.

ODFW stocking of Waldo Lake occurred from 1938 until 1990. In 1991 stocking of the lake was discontinued due to a threatened lawsuit by the Waldo Wilderness Council for adding organic matter into the lake. Species stocked by ODFW include rainbow trout, brook trout, cutthroat trout, and kokanee. Reproducing populations of rainbow trout, brook trout, and kokanee currently exist in Waldo Lake.

SALMONID LIMITING FACTOR ANALYSIS - PHYSICAL HABITAT REQUIREMENTS

In general, salmonids require four kinds of habitat throughout their lifetime. These include spawning, rearing, adult, and overwintering habitats. All of these habitats are important and a lack of any one may be sufficient to limit the potential size and overall health of the population. Parameters other than habitat, such as water temperature and food may also limit populations although it is thought that physical habitat is more often limiting than food (Benhke, 1992).

Large pools that have sufficient cover provide essential resting and feeding areas for adult salmonids. Adult habitat is thought to limit trout populations in most high gradient Western streams (Benhke, 1992). This also appears to be the case in the North Fork Watershed. Large pools are in low numbers throughout the watershed. The main stem North Fork as well as almost all of the major tributaries of the North Fork are currently below objective levels (Appendix I) and lower than historical pool numbers in the main stem of the North Fork (Table 13 of this chapter). Large wood is an important component of large pool formation, especially in alluvial reaches. Large wood is also important in high gradient reaches as it provides cover for adult salmonids. Without this major pool forming structure, adult habitat is limited. Large woody material levels are currently lacking for the main stem of the North Fork and the majority of its tributaries (Figures 9, 11 through 17 of this chapter).

Suitable spawning areas are also important for maintaining healthy salmonid populations. Spawning success may be poor if areas of silt-free gravel's are not available (Benhke, 1992). Currently, the main stem North Fork and most of its tributaries probably have gravel's sufficient for spawning. However, there are areas of concern for future addition of sediment to the watershed. All of the subwatersheds except the Lower Christy Creek Subwatershed (174) have evidence of mass wasting, but not nearly to the extent of the North Fork Middle Fork Subwatershed (175) which has many sites of mass wasting (both management induced and naturally slide-prone areas). Large wood is also an important component of maintaining suitable spawning areas as it allows the sorting and storage of spawning gravel's, especially in high gradient streams where the current is sufficient to carry suitable gravel's downstream.

Rearing areas are another potential limiting factor for salmonid populations. Suitable rearing areas usually have a low water velocity and large amounts of cover. Areas such as stream margins, spring seeps, side channels, and small tributaries generally make suitable rearing areas (Benhke, 1992). Streams with high gradients and high velocity in the North Fork Watershed may lack suitable rearing habitat. Lower gradient areas within the watershed may also be limited due to a lack of side channel habitat although there are small tributaries and margin habitat that would be suitable rearing areas.

Overwintering habitat is also important for salmonids. Overwintering habitat is composed of deep water habitat with low velocities and high amounts of cover (Benhke, 1992). In higher gradient reaches of the North Fork Watershed large boulders create suitable habitat while in the alluvial reaches large wood is an important component. Due to the lack of large wood and hence a lack of large pools and side channels in the North Fork and its tributaries, overwintering habitat is probably a limiting factor in these alluvial sections of the watershed. In small tributary streams with high winter velocities, trout may migrate downstream to overwinter in larger, deeper areas (Benhke, 1992). Many of these small tributaries have culverts making migration back upstream in the spring impossible. Population information for resident trout is lacking.

Water temperature can also be a limiting factor for salmonids, although this does not appear to be the case in the North Fork Watershed. Temperatures in the main stem North Fork and its tributaries have maximum average temperatures below 70 degrees F (see Water Quality, stream temperature section of text). Salmonids will cease feeding at temperatures exceeding 72-77 degrees F. Rainbow and cutthroat become stressed when temperatures are above 72 degrees F and die when temperatures exceed 82-84 degrees F. (Benhke, 1992). The tributaries to the North Fork have generally lower water temperatures and are therefore important cold water refugia when water temperatures in the main stem North Fork are elevated during portions of the summer.

AMPHIBIAN DISTRIBUTION

Reference Conditions

Very little information exists on the historic species composition of amphibians in this watershed.

Current Conditions

Table 25 of this chapter shows the amphibian species located in the Oregon Cascades as well as the level of concern for each of the species by various agencies. Species of concern observed in the North Fork Watershed include the tailed frog, considered a protected, sensitive/vulnerable species by ODFW, a species of concern by the Oregon Natural Heritage (ONH) Database, and a BLM assessment species, the red-legged frog, a sensitive species of undetermined status by ODFW, a species of concern by ONH, and a BLM tracking species and the cascades frog, a protected, sensitive/vulnerable species by ODFW, and an assessment species by BLM. Subwatersheds 172, 174, and 175 contain species of concern within the North Fork Watershed.

Several species of amphibians were observed in the North Fork Watershed (Appendix G). Species such as the rough skinned newt and pacific giant salamanders were observed throughout the watershed while other species were less common. Other salamanders found within the watershed include the long toed salamander (Lowell Creek, subwatershed 173), the Northwestern salamander (tributary to Perdue Creek, subwatershed 174), and the Dunn's salamander (McKinley Creek, subwatershed 175). Species of frogs were also observed including the tailed frog (Devil's Canyon Creek, subwatershed 172; and High and Chalk Creeks, subwatershed 175), the cascade frog (Evangeline Creek, subwatershed 174), and the red legged-frog (Chalk, Hammer, and McKinley Creeks, subwatershed 175).

Two species of salamanders were observed in Waldo lake: the northwestern salamander (Ambystoma gracile) and the rough skinned newt (Trachia granulosa). Only adults and larvae of these species were found in Waldo Lake. No egg masses have been located in Waldo lake itself although there are several small ponds in the area which could be used for egg laying and early larval development. Frogs and toads were abundant in the nearshore areas of Waldo Lake. Species identified include the cascade frog (Rana cascadae), the western toads (Bufo boreas), and the tree frog (Hyla regilla).

Table 25: Amphibian Distribution and Sensitivity in the Westslope Cascades Province

Species	Occurrence In Province	ODFW Status	ONH Status	BLM Status	USFS Status	USFWS Status
Northwestern Salamander	throughout					
Long-Toed Salamander	throughout					
Roughskin Newt	throughout					
Cope's Giant Salamander	few localities	Pr-S/u	2	AS	S	
Pacific Giant Salamander	throughout					
Cascade Torrent Salamander	few localities	Pr-S/v	4	TS		
Clouded Salamander	throughout	S/u	3			
Oregon Slender Salamander	few localities	S/u	1			
Ensatina	throughout					
Dunn's Salamander	throughout					
Larch Mountain Salamander	few localities	S/v	3	ROD	ROD	C2
W. Red-Backed Salamander	few localities					
Western Toad	few localities	S/v				
Pacific Chorus Frog	throughout					
Tailed Frog	throughout	Pr-S/v	4	AS		
Red-Legged Frog	throughout	S/u	4	TS	S	C2
Cascades Frog	throughout	Pr-S/v	3	AS		
Spotted Frog	few localities	Pr-S/c	2	BS		C1
Foothill Yellow- Legged Frog	few localities	Pr-S/v	4	TS		C2
Bullfrog	few localities					

Key To The Different Status Codes:

ODFW (Oregon Department of Fish and Wildlife)
Pr = Protected
S = Sensitive
c = Critical
v = Vulnerable
p = Peripheral , naturally rare
u = Undetermined status

ROD = Record of Decision for Amendments to USFS and BLM Planning Documents within Range of the Northern Spotted Owl, April 1994; survey and manage species

OHN (Oregon Natural Heritage Database)
1 = Threatened throughout range
2 = Threatened in Oregon only
3 = Review

BLM (Bureau of Land Management)
TS = Tracking Species
AS = Assessment Species
BS = BLM Sensitive Species

USFWS (Fish and Wildlife Service)
C1 = Candidate, sufficient information
C2 = Candidate, insufficient information

USFS
(Forest Service, Region 6)
S = Sensitive

(from Applegarth, 1995)

INVERTEBRATES

Reference and Current Conditions

Very little information exists about historic or current macroinvertebrate populations in this or other watersheds west of the Cascade crest. Information is also lacking on populations of zoo- and phytoplankton in the numerous lakes in the watershed. An exception is Waldo Lake, which has received much more study over the years. Phytoplankton primary production and chlorophyll A concentrations in Waldo Lake are reported by Larson et. al. (1991) to be the least ever reported for freshwater lakes. Zooplankton populations in Waldo Lake are also sparse throughout the water column but are thought to be more abundant near the lake bottom (Aquatic Analysts, 1990). Recent data analysis by Larson (personal communication, 1995) indicated that primary productivity and zooplankton populations have increased since 1969.

Social

RECREATION

Reference Conditions

No recreation facilities or use, as we understand the terms, occurred within this area prior to modern times. These activities probably had little effect on the physical nature of the watershed other than those created by the presence and use by a small number of those peoples.

Recreation activities within the forest (by European settlers in the early 1900's) usually consisted of groups of men hunting and fishing, (providing that food collection was not the main reason for the activity), as noted in Judge Waldo's excursions to Waldo Lake in the late 1800's.

Trails were used as transportation routes, not for leisure pastimes. As the forest became more accessible to power equipment, it became important as a source for boosting the local economy.

Current Conditions

Wild and Scenic River

More use occurs on the lower, scenic portion during the summer by local swimmers. Use of the 86 inventoried dispersed sites was estimated in 1991 to be 32,500 RVD's (recreation visitor days). 1991 use for Kiahani campground was 12,200 RVD's, well below its carrying capacity, but preliminary data for 1994 showed a significant increase.

There are no facilities for human waste at dispersed sites. Water quality is monitored, and no increase in fecal coliform (Eschericii coli) has been observed. The popular dispersed sites are occupied most summer weekends, and into the week. Trash is often not packed out, and Oakridge recreation personnel must clean the sites on a weekly basis during the summer. Portions of the river corridor have been used for illicit disposal of household trash.

Scenic Resources

Aufderheide Drive interpretive tapes are available at no charge from Oakridge and Blue River Ranger Stations. The brochure has been updated to reflect changes, but the tape has not. There are five points of interest identified, with interpretive signs and or trails. Use occurs mainly in the summer. Snow usually blocks the road during the winter since this road is not maintained for winter travel.

Timber harvest is apparent from Aufderheide Drive in the upper and middle river corridor. The Wild and Scenic River corridor does not now meet the 50% old-growth conditions prescribed by the North Fork Wild and Scenic River Plan, due to past harvest activities. Timber harvest units do not dominate the scene or significantly affect the view (USDA 1992, p A-8). Timber harvest units in the upper and middle portions of the viewshed are partially visible from the Byway do not dominate the visual environment.

There has been a noticeable increase in passenger car use of Road #19. Impacts from car exhaust are unknown. People tend to stop at designated areas, which are hardened to accept increased use. There may be some loss of vegetation at scenic overlooks and stops, due to people moving outside the hardened area. Social impacts of this use are not great, because people engaged in this activity are generally not there for solitude.

Waldo Lake

Summer-- The four developed campgrounds on Waldo are seldom at capacity (775 Persons At One Time [PAOT's] for Shadow Bay, 685 PAOT's for Islet, and 730 PAOT's for North Waldo. At 10 PAOT's, the Rhododendron Island campground is often used beyond its capacity. The 49 documented dispersed sites around the lake receive moderate use with a few being heavily used favorites. Non-motorized boaters have generally expressed their dislike for gas motors primarily due to noise, the lingering smell of exhaust, and potential water pollution. Campgrounds are not usually filled to capacity, except on Labor Day weekend. Dispersed sites on islands are heavily affected by users trampling, camping on, and burning sparse vegetation. The most popular dispersed sites have areas of bare, compacted soil. Less popular sites are often only distinguished by the presence of fire rings. Impacts of the use of these sites tend to be social ones, such as displacement and crowding. Both reduce the satisfaction gained from this recreation experience.

Winter-- Snowmobiles use Forest Road 5896, 5897 and 5898. The 1990 Forest Plan restricts use to these roads. Snowmobilers disagree with this restriction and would like to be able to use their machines off existing roads. Cross country skiers do not usually utilize this area. Snowmobiles do not currently damage vegetation because the routes are located over existing roads. Snowmobilers and cross country skiers rarely meet, due to trail head and trail layout (separate trailheads, no parallel trails and right angle crossings when the two meet). Snowmobile trails are not groomed and the trailhead is small and sloping. Although the snow is wetter and heavier than the east side, it tends to remain longer than snow in the Crescent Lake area.

River Boating

Expert kayakers discovered the lower nine miles of the North Fork in the early 70's. Kayaks can use the section below the "gorge" during most of the year, although higher flows (during spring runoff) are desirable. Above the gorge is exclusively kayaking, where high flows (600 CFS plus) produce boatable waves. Rafters generally utilize the river only during times of high flow; mostly below the gorge. Advanced kayakers usually run from the gorge down, in flows of 300-400 CFS. Due to the technical skills needed, the short season and proximity of other good white water rivers, the use is low. The stretch between Kiahanie campground and the gorge is not as technical, and receives sporadic kayak use because the rapids are not as technical, and it is not considered to be particularly interesting boating.

Only private parties run the river; no outfitter guides are allowed on the North Fork. User formed access paths are visible at put ins and take outs (the top and bottom of the gorge). There are no apparent effects on water quality due to kayak use.

Christy Creek is also run by a handful of advanced kyakers. It is considered an extreme run, a class 5+. Technical improvements now allow kayaking of "...incredibly steep, small streams".

Tributaries to the North Fork besides Christy Creek may also have begun to experience this type of activity.

Fishing

The North Fork River is designated as fly fishing only. The opportunity for solitude is desired by many who fish these waters. Because the river is fly fishing only, it caters to a different kind of angler. Many anglers "catch and release", which helps maintain fish populations. Some anglers think because the fish are small, the river is overstocked and would like to see an open fishery. Most anglers currently fishing the river enjoy not seeing many people. Anecdotal evidence suggests that use has increased by 50 to 100 percent over the past 10 years. Most use is below the Brock Bridge but some use occurs from the Shale Ridge trail head to the Brock Bridge. Little use occurs above the Shale Ridge trail head.

Fish are not native to Waldo Lake, but it was stocked for some time and these fish have become a self-sustaining population. It still remains an art to successfully fish Waldo (it has never been easy), and fish have not noticeably declined since stocking was stopped.

Swimming

Most swimming occurs in the lower four miles of the North Fork. User formed trails down steep slopes access favorite swimming holes. Trash and human waste are found, but are not prevalent. Crowding does not appear to be a problem at this time, though parking areas are often full on hot days.

ROADS

Reference Conditions

No road system existed prior to European settlement. Early Forest Service documents indicate that the agency used existing Native American trails for administrative use. The first roads were built in the early 1920's.

Current Conditions

There are approximately 570 miles of system, nonsystem, and private roads within the watershed boundary (Figure 33). These roads access log landing, dispersed recreational sites; trail heads; campgrounds; homes; fire lookout; interpretive site; facilities; horse camp; guard station; mine clam's; North Fork of the Middle Fork of the Willamette Wild & Scenic River; Aufderheide National Scenic Byway. There are 15 major bridges and 27 major culvert crossings within this watershed. The roads are used by the general public, commercial users, and for administrative purposes. Of the 570 miles of road 52 miles are nonsystem (logger spurs); 12 miles are maintenance level one roads; 320 miles are maintenance level two roads; 113 miles are maintenance level three roads; 58 miles of maintenance lever five roads; 15 miles are private roads. Maintenance level five roads are double lane & single lane paved. Maintenance level five roads have been maintained for recreational vehicles and passenger cars and use is encouraged. Maintenance level three roads have been maintained for recreational vehicles and passenger cars, are gravel surfaced with turnouts, and use is accepted.

Maintenance level two roads have been maintained for high clearance vehicles, are gravel surfaced with turnouts, and use is discouraged though reduced maintenance. Maintenance level one roads have been maintained only for drainage structures and may not be drivable. They may be gravel surfaced or native surfaced and may not have turnouts and use is discouraged through lack of maintenance. Non-system roads (logger spurs) are not maintained and traffic is discouraged.

The historic cost of maintaining at standards for these levels are as follows:

- Maintenance level one = $160/mile
- Maintenance level two = $660/mile
- Maintenance level three through five = $1,140/mile.

In the past these roads have been maintained via programmed dollars and or timber sale collections. The projected programmed dollars are decreasing and the timber sale program has decreased. The entire projected budget for road maintenance for the district in FY 96 is only $176,000. At this time only level three and five roads are being maintained in the watershed. Brush is starting to grow in on the level two and one roadways. In some cases it is making travel difficult if not impossible by vehicle on these roads. There are currently approximately 135 miles of existing trails in this watershed.

Figure 33: Miles of Road by Maintenance Level

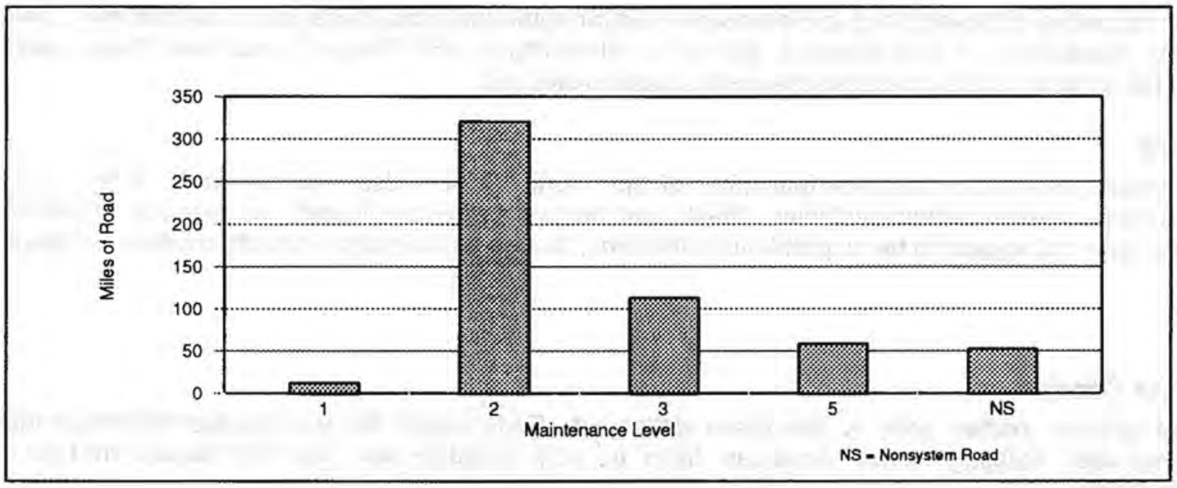


Table 26 is a listing of culverts by PSUB within the watershed. They are listed by culverts that are not damaged, partially blocked, or have some type of problem but remain functional. This information is from the WIN database. Figure 34 is a graphic display of culvert conditions within the watershed.

Figure 34: Culvert Condition

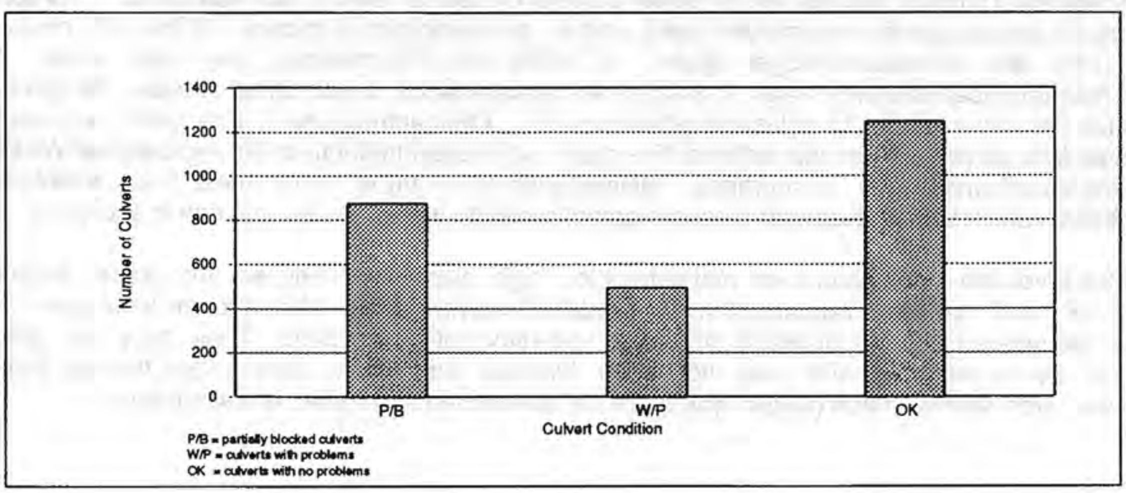


Table 26: Culvert Condition in the North Fork Watershed (see Figure 34 also)

P - Sub	No. of Culverts Partially Blocked	No. of Culverts with Problems	No. of Culverts OK	Total No. Culverts
171	13	11	30	54
172	24	9	21	54
173	17	5	22	44
176	0	0	1	1
177	9	4	30	43
178	10	10	17	37
179	54	33	55	142
17B	9	0	0	9
17C	18	2	31	51
17D	14	0	15	29
17E	21	7	52	80
17F	15	4	0	19
17G	31	7	46	84
17H	19	8	11	38
17I	44	38	24	106
17J	58	57	42	157
17K	89	39	24	152
17L	83	36	55	174
17M	67	46	48	161
17N	36	21	50	107

P - Sub	No. of Culverts Partially Blocked	No. of Culverts with Problems	No. of Culverts OK	Total No. Culverts
17P	25	5	22	52
17Q	28	13	31	72
17R	26	3	23	52
17S	17	31	57	105
17T	30	11	41	82
17U	22	14	52	88
17V	28	17	60	105
17W	37	25	39	101
17X	10	11	30	51
17Y	5	5	49	59
17Z	5	9	40	54
18Z	0	3	0	3
20B	0	1	0	1
20V	0	1	0	1
20X	1	0	0	1
24D	1	0	7	8
24E	4	6	15	25
24F	1	0	5	6
24I	2	0	1	3
Totals	873	492	1246	2611

MINING

Mining activity has been rather limited in the North Fork analysis area. Most of the mining activity has been historic claims within the Christy Creek drainage. In the entire North Fork analysis area there have been 141 claims previously recorded with no current notices of intent or assessments on file. Currently, only 2 claims have updated assessments with one having a notice of intent filed for a small sampling operation

Mineralogical studies by the Oregon Department of Geology and Minerals Resources on the Fall Creek Mining District 1983, have indicated that several metals including gold, silver, and copper may be present in commercially recoverable quantities within the North Fork River corridor but more likely exist in higher concentrations in the Christy Creek area.

No geothermal, oil, gas leases or lease applications exist in the North Fork analysis area. At this time, recreational suction dredging has not occurred nor have permits been applied for.

INTERPRETATION

CHAPTER IV

INTERPRETATION

Introduction

This section is a synthesis and interpretation of the information presented in previous sections. It specifically resolves or interprets the import 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 each 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.

The acreage of various successional stages has not been changed appreciably across the whole watershed by vegetation management from the amounts of various age classes present prior to harvesting initiation and fire suppression. However, the pattern created across this landscape is now quite different from any pattern that has ever existed within this watershed in the foreseeable past.

Previous to vegetation management, the area west of the main channel of the North Fork typically had little edge habitat and abundant late-successional, interior habitat between the infrequent, landscape scale fires. This area is now highly fragmented and though late-successional forest still exists, it now contains little functional interior habitat due to the fragmentation that has occurred. The upper North Fork typically contained many acres of young stands generated by frequent large fires. This area now is almost totally occupied by mature forests. This area contains the Wilderness Areas and portions of the Late-Successional Reserve. Reserves located in areas prone to relatively frequent, large wildfires may not provide late-successional habitat over the long-term. Additionally, young fire stands often included riparian areas, especially in upper drainage areas.

Projecting current management direction into the future results more or less in a continuation of the current pattern. The steeply dissected slopes west of the river will continue to be managed relatively intensively (i.e., harvest rotations shorter than natural fire rotations), creating abundant edge and necessitating the maintenance of an extensive road system. Currently programmed intensive forest management will tend to keep substantial acreage's of this portion of the watershed in a hydrologically unrecovered condition. Elevated peak flows can mobilize sediment generated by natural slope failures and sediment stored behind in-channel structures.

Large acreage's with low hydrologic recovery percentages and many miles of open road could contribute to a chronic sediment generating condition, though roads typically produce most of the management generated sediment production. This may be of particular concern in the area west of the lower North Fork. This area has a dense stream network, areas of deep and potentially unstable soil, a high percentage of area within the transitional snow zone, and many areas of known slope instability adjacent to stream channels. Though riparian reserves will not be disturbed by harvest in the future, the currently programmed intensive management of the uplands will keep this area in a relatively fragmented condition. Though riparian reserves will provide functional habitat for some species (small patch and contrast guilds), riparian reserves are not wide enough to provide much, if any, interior, late-successional habitat.

ISSUE #1 KEY QUESTIONS

QUESTION 1

Given current Forest Plan (as amended) land allocations, where and how many acres are available for vegetation manipulation (especially timber harvest)?

Though the watershed contains relatively large acreage's of land allocations providing for timber harvest (see Table 1 of the Characterization chapter), a small percentage will be available for regeneration harvest over the next two decades due to the amount of regeneration harvest that has occurred in the past, and due to the amount of unsuited lands and riparian reserves. In the next 20 years approximately 4300 acres of General Forest management area, 1394 acres of 11a management area, 5200 acres of 11c management area, and 1100 acres of 11d management area would be available for regeneration harvest. These acreage's are only potentially available; various resource objectives such as overall viewshed conditions, big game habitat conditions, maximum allowable opening size restrictions, hydrologic recovery conditions, etc., may limit the amount of this timber that could be harvested in any given period within all Management Areas.

It is beyond the scope of this analysis to indicate exactly how many acres could be harvested given various Forest Plan objectives, especially in terms of hydrologic condition, big game habitat conditions, or visual quality objectives. It is also beyond the scope of this analysis to indicate exactly where these acres are available, but generally each sub-watershed with Forest Plan Management Areas providing for harvest has some areas available for regeneration harvest in the next ten years, with the exception of the Huckleberry Flats area and the Wild and Scenic River corridor, which have only areas available for commercial thinning, and of course those areas currently allocated to non-harvest uses such as wilderness. No area has substantially larger regeneration opportunities than do others, though a number of sub-drainage's (17-C, D, E, F, G, H, I, I, Q, and 17-1 through 8) have limited near-term opportunities due to a combination of past harvest and hydrologic sensitivity.

Approximately 22,000 acres will be available for commercial thinning over the next 20 years, depending upon how young stands develop, in areas previously harvested. This acreage includes riparian reserves, as this analysis has shown thinning of young, dense riparian stands to be, in the balance, beneficial to attainment of Aquatic Conservation Strategy objectives and Forest Plan objectives for availability of large woody material. These commercial thinning opportunities occur throughout the watershed, including the portion within the Late-Successional Reserve. Opportunities are concentrated in the northern portion of Huckleberry Flats, the North Fork Canyon west of Huckleberry Flats, and the eastern end of Christy Flats

Approximately 16,000 acres will be available for precommercial thinning and/or forage enhancement cutting over the next 20 years, including acres that may be harvested in the next 10 years. Virtually all the 50,000 acres that have been harvested are available for fertilization. The scope of this analysis was not intensive enough to identify fertilization needs. Such needs should be determined by site-specific analysis of plantation health, growth rates, and site conditions such as the need for buffered wetlands.

QUESTION 2

How has the intensity and pattern of vegetation manipulation (as compared to the change from prehistoric conditions) affected plant and animal habitat diversity, species composition, species viability, amount of interior habitat, habitat connectivity?

INTERIOR FOREST VS. EDGE HABITAT

As timber harvest strategies were applied in the watershed, the abundance of late-seral and old-growth habitat was decreased and the size of retained habitat blocks was reduced as forest fragmentation progressed in watershed 17. Just as edge habitat increases with moderate levels of fragmentation, interior habitat decreases. As described above, this has likely resulted in a shift in the biotic community as less high quality interior late-seral forest habitat and more fragmented forest and early to mid-seral habitat became available in watershed 17. 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 the species that select for large blocks of interior habitat. These effects have decreased the capability of the portion of this watershed in LSR 0219 to attainment of management objectives for the LSR. This LSR currently has 20 of 31 spotted owl sites with home ranges above 40% suitable habitat. With this LSR and within the Wild and Scenic River corridor interior late-seral habitat conditions 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 the seral stage maps (Figures 18 and 19 of the Reference/Current Condition chapter) reveals that the distribution and amount of edge habitat has disproportionately increased in the western half of the analysis area (watershed 17) and that average patch size is small relative to natural conditions. This trend may have resulted in a shift in the biological community, with a decrease in medium and large home range patch species (i.e. rosy finch), mosaic species (i.e. spotted owl and fisher), and an increase in small home range guilds and contrast species (ie. 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 harvest.

However, on the eastern half of the analysis area (watershed 24), forest fragmentation has been less prevalent and relatively more late-seral habitat and old-growth is present than in the historic example (compare Figures 18 and 19 of the Reference/Current Condition chapter). This trend occurs 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 than what existed 100 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 and late-seral habitat users. This effect has increased the capability of the portion of this watershed in LSR 0220 to contribute to meeting management objectives for the LSR. This LSR currently has 22 of 30 spotted owl sites with home ranges above 40% suitable habitat. The quality and contiguity of interior late-seral habitat should generally continue within the LSR and along the Wild and Scenic River corridor.

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 under an 80 year rotation and Scenic Partial Retention under a 100 year rotation (which do not allow for return of stands to late-seral conditions). This scenario of edge habitat limitations is also expected to occur in the larger LSRs as early and mid seral stands mature and additional removal of timber (establishment of early seral conditions) is restricted. The exceptions to this trend may be for small home range species which have relatively small minimum patch sizes and may be afforded suitable habitat by the prescriptions for timber harvest on the matrix; and for sections of the watershed that have high densities of riparian reserves which will provide the late-seral component of edge habitat along harvested stands in the matrix. Though edge habitat may generally decrease across the landscape over time, edges would be concentrated along riparian reserves, along Supplemental and larger LSRs, along the Wild and Scenic River corridor, 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 watershed 17. The vegetational elk habitat effectiveness has increased over time for much of the watershed in response to the arrangement of timber harvest units which strategically places 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 of no interspersed cover (such as Christy Flats, Huckleberry Flats, lower McKinley Creek and Grassy Creek).

HABITAT STRUCTURE

Approximately 16,000 acres were intensively harvested prior to 1970. On these areas snag levels may be variable, but are generally well below natural levels. 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 until existing regeneration begins to contribute large woody debris to the forest floor. As a result, species that utilize snags and down logs as habitat may become less abundant in these areas 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 species.

Approximately 17,000 acres have been intensively harvested between 1970 and 1989. These areas generally have low levels of both snag and large woody debris as a result of lower utilization standards and PUM/YUM logging 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.

Though approximately 1,200 acres have been harvested between 1990 and present, many of these acres included prescriptions that were in place prior to 1990. 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 the number of snags retained is generally higher. Smaller snags and logs will not persist as long and will not accommodate as large of cavities, or retain temperature and humidity as well as larger diameters. Thus, the trend toward leaving smaller wildlife trees has resulted in habitat that will not provide for all cavity dwelling species (for example pileated woodpeckers and colony nesters). This habitat may not be as effective in providing shelter to temperature and humidity sensitive species (for example 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 28 in Reference/Current Conditions (chapter III) shows, potential connective corridors associated with riparian reserves have been exposed to habitat altering activities which 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 or may not provide enough cover to allow successful movement through the area by some species. Adjacent positioning of sub-populations provides for genetic exchange in species that do not migrate. Without adequate connectivity of suitable habitat across the landscape, such populations may become isolated. Isolated populations may ultimately be detrimentally affected by genetic drift.

Comparison of management allocations in Figure 3 of the Characterization chapter and the currently unharvested connectivity areas from Figure 28 of the Reference/Current Condition chapter, indicates that there are gaps in connective corridors between LSR 0220 and LSR 0219. Though this may not impede genetic exchange between more mobile species such as northern spotted owls and pileated woodpeckers, it may reduce the exchange of genetic materials between less mobile species that may rely on habitat characteristics not currently present in managed stands.

Potential landscape linkages between LSR 0219 and LSR 0221 are somewhat limited by the positioning of Lookout Point Reservoir and private land associated with the communities of Oakridge and Westfir. Connectivity of habitat for less mobile species is further complicated by the presence of the Middle Fork of the Willamette River, Southern Pacific Railway and State Highway 58. The most direct linkages between these LSRs along riparian reserves occur west of this watershed boundary. However, connections along that route cross two prominent ridges and include a number of previously harvested riparian reserves. Most of the riparian reserves within this watershed between these LSRs are oriented west to east, rather than north to south, with the exception of lower Christy Creek and the North Fork. Riparian areas associated with the Wild and Scenic River corridor and Christy Creek have potential to provide connections between LSRs with the exception of the southern two miles adjacent to the community of Westfir, the railroad, highway, and river (refer to Figure 28 of the Reference/Current Condition chapter).

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. The review of 50-11-40 analysis for these watersheds indicates that several quarter townships in watershed 17 are at or below the level considered to be adequate to provide for dispersal of northern spotted owls. However, all quarter townships in watershed 24 are currently well above the minimum level for dispersal. Of the quarter townships below the threshold, those of particular concern are positioned between LSR 0220 and LSR 0219 and within LSR 0219. The effect of having low levels of habitat suitable for dispersal between LSRs is that genetic exchange between LSRs may not occur as effectively for some species. Within LSRs low levels of dispersal habitat, like low levels of suitable habitat, compromise the capability of the LSR to function for its intended purpose.

Though potential habitat is present in the area for peregrine falcons, occupancy has not been observed. The area with the highest potential is relatively remote and is not accessed by existing trails, thus potential for adverse impacts to falcons by recreational use of existing facilities is low.

Both bald eagles and peregrine falcons can be adversely affected by low altitude flights by aircraft. Thus fire suppression activities should be coordinated so as to minimize the risk of disturbance to nesting raptors during fire suppression efforts. As most wildfires occur after the critical nest initiation to fledging period for falcons, the greatest concern would be for bald eagles which generally do not fledge until after mid June.

PLANTS --HABITAT DIVERSITY / INTERIOR HABITAT / CONNECTIVITY

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, in some areas, is 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.

<u>QUESTION 3</u>

How has the intensity and pattern of vegetation manipulation (as compared to the change from prehistoric conditions) affected site productivity?

EROSION

Compared to the historic fire pattern, Watersheds 17 and 24 have altered the spatial and temporal distribution of non-vegetated condition on erosive soil. Stand replacement fires in Watershed 17 tended to be larger, localized blocks rather than the dispersed patchwork of clearcuts in varying stages of vegetative recovery currently exhibited. In Watershed 24, they tended to be very large blocks with a reoccurrence interval around 60 years rather than the relatively minor amount of area impacted by clearcut harvest.

This reversal of patterns may or may not be beneficial to the system in terms of decreasing natural erosion levels. Larger stand replacement fires would tend to have a high impact to a few drainage's until vegetation is reestablished. The dispersed patchwork of clearcut units would tend to have a lower impact on individual drainage's, but would be distributed over a larger area and over longer periods of time.

In contrast to past management practices, the recent change toward the retention of more trees, snags, riparian areas, and LWM comes closest to mimicking historical fire impacts. The residual root strength from the trees and snags, the energy dissipating effect on overland flow that riparian reserves and LWM provide, and the fact that LWM can reduce the velocity and distance traveled of future debris torrents all tend to keep more soil on the hillside over time.

COMPACTION

Past harvest practices, notably on the roughly 15,000 acres harvested prior to 1970, included extensive use of tractors (skidders and cats) on gentle ground. Approximately 3000 acres of this was on high clay content soil that tends to be especially sensitive to compaction and soil disturbance. This harvest technique is not used as much as it was in the past and the amount of area compacted has leveled off. However, the effects of compaction can still be seen as evidenced by a reduction of height growth in trees.

Compaction has generally resulted in a reduction of site potential by up to one site class, which, over the span of an 80 year harvest rotation, may result in as much as a 25 percent reduction in stand volume growth. Additionally, soil compaction can increase the pathology of otherwise endemic natural root disease pathogens. Black stain (Ophiostoma wageneri) and armillaria (Armillaria ostoyae) root rots exist in the watershed and seem to be increasingly evident in plantations yarded with compacting ground-based yarding equipment. Further progression of these diseases could change the productivity of these sites from a timber growth perspective due to resultant understocking.

ORGANIC MATERIAL / NUTRIENT CAPITAL

Approximately 16,000 acres were harvested during the 1960's to 1980's when regeneration harvest utilization standards where high, little large woody debris was retained in harvested areas, and harvested sites were typically burned in the fall under dry conditions. Little is yet known about the long-term implications of such efficient harvesting methods. Several long-term studies are underway to quantify site productivity effects of retention of large wood but results are decades or more away. While it seems intuitive that removal of most of a site's above ground biomass could have negative effects on long-term site productivity, it is also known (see the Vegetation section of the Characterizations chapter) that fires may burn an area twice in a short time, effectively removing most above ground organic material. The amount of high utilization harvest that has occurred within this watershed is within the scope of the number of acres potentially affected by short return interval fires, and has not likely appreciably affected long-term site productivity more than has natural processes. In any event, infrequent removal of most biomass probably affects a site's inherent productivity less than does soil compaction. Nutrient levels are often maintained after near total biomass removal by the growth of various nitrogen-fixing plants (primarily Ceanothus species), commonly found in recently burned areas. It is thought that harvest has not affected site productivity much at all other than the effect from soil compaction.

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, and peak flow changes? Where have these changes in hydrology affected channel function and habitat condition?

WATER YIELD

Water yield has varied over time due to changes in the vegetative condition as a result of wildfire and timber harvest. During time 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 water yield Classes II and III land types, areas 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, but typically fall precipitation exceeds soil field capacity quickly, regardless of vegetation development (i.e., transpiration in this area does not affect storage capacity during the wet seasons).

Figure 1 of the Reference/Current Condition chapter indicates that subwatershed 175 has a relatively high proportion of its area as water yield class I. This area contains a significant area of landforms associated with deep seated mass movements. The parent material associated with these landforms typically have a relatively high clay content which generally would have a relatively low transmissivity of sub-surface water. The capacity of the ground surface to infiltrate water is sufficient that overland flow is unlikely even during times of high soil water input. Due to the relatively low transmissivity of deep subsurface layers, water may be rapidly routed to the stream network through macropores present in the A and B soil horizons. Therefore the ability of the planning subdrainages within subwatersheds 171 and 175 which have relatively large areas composed of soils of high clay content may be more accurately described as having a greater proportion of areas in water yield Classes II or III which have can greatly contribute to peak stream flows. The following planning subdrainages can be placed into this category; Hammer (17E), Chalk (17G), Coffee (171), McKinley (17F), and High (17D).

Overall water yield Class III (low ground water storage capacity) is highest in the Upper North Fork (watershed 24), however the average slope is lowest within the majority of this area and runoff can be stored within hundreds of lakes. In addition, the seasonal snowpack in a large portion of watershed 24 contributes to baseline flow during all or portions of the low-flow summer period. Therefore even when a majority of the Upper North Fork was in an early successional condition due to large wildfires resulting in reduce evapotranspiration, this area would have the ability to temporarily store much of the available water in surface features and infiltrate soil water input into streams and deep aquifers.

PEAK STREAMFLOW

ARP values are a measure of the potential for an area to experience increases in peak stream flow as a result of changes in vegetative condition due to management activities or wildfire 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. 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 sub-drainage's with a high proportion of their area within the transient snow zone combine with high road densities may be particularly sensitive to this effect. All sub-watersheds in the lower North Fork fall into this category.

Overall, planning subdrainages and subwatersheds in the Lower North Fork (watershed 17) would have the greatest risk of increased peak flows due to management effects. This area is predominantly within the transient snow zone, has a relatively high stream and road density, and has experienced, and will continue to experience, the greatest amount of timber harvest. The planning subdrainages of particular concern are those that are currently at or within five percentage points of the mid-point ARP. Those planning subdrainages in this category are; Chalk (17G), Dartmouth (17B), and High (17D).

WATER QUALITY

Stream Temperature

Generally where streams have been impacted by management activities such as timber harvest, summertime water temperatures tend to be elevated. Several streams in the Lower North Fork do not currently meet the state standard of 58 degrees F during the summer season. Monitoring data indicates the following streams are of particular concern; Lower North Fork (main stem), Christy Creek, Lowell Creek, and Huckleberry Creek. A slow trend of temperature recovery to natural levels is expected as riparian vegetation recovers in areas previously harvested.

Stream Turbidity

Turbidity levels have increased above natural levels in the lower North Fork (watershed 17) due to management activities associated with timber harvest. Chronic sediment sources are increasing turbidity levels especially where past management activities have impacted areas of active land flows composed of soils with a high clay content. The largest chronic source of turbidity for the North Fork at this time is the Chalk Creek planning subdrainage (17G). During relatively short periods of time, turbidity values have reached levels exceeding 40 NTUs (Nephalometric Turbidity Units) in the lower North Fork. Although research has shown that turbidity values of this level can interfere with the ability of salmonids to find prey, because of the short-term nature of these events it is unlikely that turbidity is causing significant long term adverse effects on fish species present in this portion of the North Fork. Increased levels of turbidity in the North Fork may result in reduced aesthetic quality during high flow events. Other sub-drainage's with a high occurrence of mass wasting in riparian areas are likely additional source areas. These include High Creek (17D), Hamner Creek (17E), and McKinley Creek (17F).

CHANNEL FUNCTIONS AND CONDITIONS

Large woody material is an important component of many streams. Large wood provides cover for fish and amphibians, creates large pools, stores and sorts sediment increasing the availability and quality of spawning gravel's, contributes to stream bank stability and contributes to 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 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 vegetative component that would require the longest time to recover from timber harvest related impact is the potential for the riparian area to supply 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.

Past management activities such as logging without leaving a 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 North Fork Watershed to levels below objective values and historical conditions (Table 1 of this chapter).

The removal of this large wood from the riparian area and the stream channels has resulted in reduced channel complexity and therefore reduced the number of areas with high quality habitat for fish and other aquatic species. Nearly every reach, surveyed in the last five years, in every 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 watershed 24 may be below objective levels for

Table 1: 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	% Of Streams Not Meeting Pacfish LWM Objective Values
Mainstem North Fork	45.6	100	100
Mainstem Christy Creek	10.8	100	78.7
Westfir (171)	13.4	50.7	26.1
Devil's Canyon Creek (172)	7.8	93.6	93.6
Upper Christy Creek (173)	21.3	76.9	65.7
Lower Christy Creek (174)	10.5	16.2	15.2
N.Fk. Middle Fk. Willamette (175)	18.9	68.8	64.6
Fisher Creek (241)	8.8	91.9	74.7

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 are effected by levels of large wood such as spawning gravel's, rearing areas and overwintering habitat (see the Aquatic Habitat discussion in Chapter IV, Reference and Current Conditions). The areas of greatest impact from timber harvest within riparian reserves are located adjacent to Class II and Class IV stream channels. These areas are primarily located in all sub-watersheds in the Lower North Fork and in sub-watershed 241 in the Upper North Fork. Sub-watersheds 172 and 173 have had the greatest impacts from stand replacement timber harvest within the designated riparian reserves. Table 7 in the Reference/Current Conditions chapter shows the percent of the riparian reserves that have been harvested. Harvest in the riparian reserves has occurred most heavily in subwatershed 173, Upper Christy Creek (45.0 %) and subwatershed 174, Lower Christy Creek (50.0%). Subwatershed 241, Fisher Creek (9.7%) has been impacted the least by harvest activities in the riparian reserves.

Table 2: Percent of Harvested Riparian Reserves in Various Age Classes by Subwatershed

Subwatershed	0-25 Years	26-45 Years	46-65 Years	> 66 Years
Westfir (171)	44%	20%	18%	19%
Devil's Canyon Creek (172)	44%	28%	20%	7%
Upper Christy Creek (173)	52%	41%	3%	4%
Lower Christy Creek (174)	51%	45%	1%	2%
N. Fk. Middle Fk. Willamette (175)	53%	29%	9%	9%
Fisher Creek (241)	53%	20%	0%	27%

Table 2 of this chapter shows the proportion of these harvested areas within riparian reserves that are within specific age classes. This table indicates the probable recovery time for subwatersheds lacking in large wood. Those subwatersheds with the highest percentage of vegetation in unharvested and harvested before 1920 categories would be expected to have natural introductions of large wood sooner than those with a large percentage of riparian areas harvested since. The Fisher Creek subwatershed has the lowest percentage of riparian reserves harvested of all those having harvest allocations (9.7%) is also be expected to be the quickest to begin to see trees naturally entering the stream. Subwatersheds expected to take a number of years to reach a point where trees begin to enter the stream channel at near natural rates include Upper Christy Creek (173), Lower Christy Creek (174), and the North Fork Middle Fork Willamette (175).

Areas composed of steep slopes with potentially unstable land forms combined with areas impacted by stand replacement harvest within riparian reserves are the primary areas where a reduction of existing and potential LWM is of greatest concern. These areas are all located in the Lower North Fork (watershed 17) and include planning subdrainages Hammer (17E), Chalk (17G), Coffee (17I), McKinley (17F), and High (17D). These sub-drainage's also contain a number of small unstable areas adjacent to stream channels (see Chapter IV Channel Stability section). Appendix I lists the percent of the riparian reserves impacted by stand replacement harvest by planning subdrainage.

Stream channels with the greatest amount of 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 an 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 5

What are the most important delivery mechanisms for sediment generated by vegetative disturbances in this watershed? What are relative rates of delivery by landform or slope to stream? Where are the high risk areas?

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", 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.

Where deep-seated landflows interact with stream channels, significant sediment sources exist. Stream survey data indicate the High Creek (17D), Hamner Creek (17E), McKinley Creek (17F), and Chalk Creek (17G) sub-drainage's have relatively high numbers of mass wasting sites adjacent to stream channels and therefore may be relatively high-risk areas for adverse impacts from management activities. Given the amount of clearcut harvesting on steep ground with shallow, rocky soil, it is surprising that no harvest related slope failures were identified in this setting. It is also surprising that naturally occurring debris slides did not increase as a result of the 1964 flood. This is a striking contrast to the frequency of occurrence in the Lower Middle Fork Willamette Watershed Analysis area that has similar geology and geomorphology to Watershed 17. This apparent lack of events, especially in areas of known risk due to soil classification and ground observations, may be due to the low resolution of the debris torrent and landslide survey technique.

Watershed 24 has not been affected as extensively by clearcut harvest on steep ground, so the lack of response is not so surprising.

Large scale clearcut harvesting on high clay content soil in Tumble Creek and the southwest flank of

Christy Flats did not result in slope movement, but is considered a contributing factor to the sensitivity of the toe slope to excavation. Camp Five Slide in sub-drainage 17Q (1981) and the cutslope failure on Rd. 19 MP 13, in sub-drainage 17F (1972) are two examples of this increased sensitivity.

QUESTION 6

Where and to what extent has removal of existing and future sources of large woody material in stream channels changed the routing of sediment and in-stream habitat?

See the answer to question 4 under Issue #1.

QUESTION 7

Where and to what extent has vegetation manipulation affected riparian habitat?

See the answer to question 4 under Issue #1.

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?

This question is addressed in the Current Conditions fuels discussion in Chapter III.

QUESTION 2

If we provided for prescribed fire within established forest stands (as opposed to bare ground for site preparation) in order to reduce high fuel loading, and to bring the landscape fuel loading back to a natural range of variability, under what conditions could we control the fire? How many acres (per period of time) could need to be burned (by land allocation) and remain within air quality limits?

During the Warner Fire Recovery Project, Charley Martin 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 become lower.

Probability 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 Chapter III.

QUESTION 3

Under a prehistoric (prefire suppression) fire regime, what would the habitat diversity look like?

Within the eastern half of the analysis area (watershed 24), 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). However, at the same time fire exclusion may have allowed late-seral habitat conditions to develop in areas that might have otherwise been exposed to repeated burns. It is difficult to assess whether fire exclusion in watershed 24 has increased, decreased or had a neutral effect on the abundance of edge habitat above and beyond that created by timber harvest without knowing the intensity and patchiness of historic fire events. Frequent reburns in the 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 pattern and intensity of fires might have been (had they not been suppressed) is difficult.

On the eastern half of the analysis area (watershed 24), forest fragmentation was less prevalent. Relatively more late-seral habitat and old-growth is present now than in the historic example (compare Figures 18 and 19 of the Reference/Current Condition chapter). This trend to more late-seral habitat continues as fire regenerated stands are allowed to mature in the absence 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 the portion of this watershed in LSR 0220 to contribute to meeting management objectives for the LSR. This LSR currently has 22 of 30 spotted owl sites with home ranges above 40% suitable habitat. On the other hand, 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, Cassins finch, Calliope hummingbird, Mountain bluebird, green-tealed towhee, and heather vole.

QUESTION 4

How would disturbance mechanisms associated with prescribed fire affect TE&S species, as well as fire dependent species?

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.

Moderate intensity fall burns may assist in germination of fire dependent species such as woodland milkvetch and branching montia. Both the Warner Creek and Shady Beach fires burned in the fall. It is unknown whether spring fires will stimulate these species to germinate.

Issue #3

The density and condition of roads and trails has altered the landscape processes.

ISSUE #3 KEY QUESTIONS

Roads (system and non-system)

QUESTION 1

Where and to what extent has the density and condition 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 lower North Fork (Watershed 17). Roads have initiated debris torrents where they likely would never have occurred naturally over the time periods we are analyzing. Roads have also increased the frequency of these events over the landscape in areas that would eventually have experienced debris slides under natural conditions. Naturally occurring landslides have historically occurred in Hamner Creek, High Creek and Chalk Creek. Road related landslides have not only increased the frequency of occurrence by more than 370%, but have expanded the affected area to drainage's adjacent to Chalk, High, and Hamner Creeks.

The vast majority of road related debris slides occurred prior to 1968 and are associated with sidecast construction techniques on steep ground. Failure mechanisms associated with this construction technique come in two stages: immediate and delayed with approximately a 20 year gap between the two.

Influxes of sediment can silt in spawning gravel's thus reducing the spawning success of trout and salmon population. Currently the main stem of the North Fork and the majority of its tributaries probably have gravel's sufficient for successful spawning. However, there are areas of concern for the future addition of sediment to the watershed. Although all subwatersheds except Lower Christy Creek (174) have evidence of mass wasting, the North Fork of the Middle Fork subwatershed (175) has the highest number of sites of mass wasting and is the subwatershed of most concern for introducing large amounts of sediment into the watershed. Mass wasting sites are present throughout most of the stream reaches within this sub-watershed. Mass wasting sites in this subwatershed are both natural and management induced. Other potential sources of large amounts of sediment are roads having plugged or otherwise non-functioning culverts throughout the watershed. The failure of these culverts could result in large portions of the entire road prism entering the stream channel.

QUESTION 2

What sections of roads are currently or potentially introducing sediment to the stream system? Where and to what extent does the influx of sediment influence channel conditions?

Although all subwatersheds, except Lower Christy Creek (174), have documented mass wasting sites, the North Fork of the Middle Fork subwatershed (175) has the highest number of sites of mass wasting and is the subwatershed of most concern for introducing large amounts of sediment into the watershed. Mass wasting sites in this subwatershed are both natural and management induced. Other potential sources of large amounts of sediment are roads having plugged or otherwise non-functioning culverts throughout the watershed. The failure of these culverts could result in sediment from large portions of the entire road prism entering the stream channel.

The majority of the road system on steep ground was constructed 20 or more years ago and is therefore likely to be undergoing the second stage of slope failure. The mode of failure begins with outside edge cracking and settlement. If sufficient water is allowed to enter these areas, the probability of failure rises significantly.

QUESTION 3

Where and to what extent has the density and configuration of roads affected surface and subsurface hydrology (i.e. wetlands, expansion of the drainage network, etc.)?

Roads contribute to increases in peak flows 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 the area within the transient snow zone devoid of a vegetative canopy. Appendix F lists the road density by planning subdrainage. The areas with the highest road densities are located in the lower North Fork. Subdrainages with road densities greater than or equal to 4.5 miles per square mile include; Huckleberry (175), Third (176), Short - Hemlock (17A), and Billy (17I).

Interception of subsurface flow by a mid slope road can result in the area below the road becoming dryer due to a routing of water away from these areas or, a road can concentrate water in roadside ditches and result in localized areas of increased surface water on the upslope portion relative to the road. In addition, surface water may be increased in those areas where relief culverts concentrate runoff from roadside ditches. Concentrating runoff from relief culverts has resulted in soil erosion, gully formation, or debris torrent initiation in some areas below the outlet of some culverts.

In some situations, roads have altered the natural hydrology by concentrating water on the upslope side. These areas many have increased soil moisture, and in some cases have created areas of standing water for a significantly long period of the year than would have occurred naturally.

QUESTION 4

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

It is currently unknown which undersized or plugged culverts pose a substantial risk for road fill breach or significant diversion of water to adjacent relief culverts. Many variables outside the scope of the inventory techniques used in this analysis need to be considered when assessing the potential for a stream crossing that hydraulic analysis indicates has a strong likelihood of being overtopped during a 100-year flood event. Some of these variables include the quantity of water overtopping, potential diversion paths, fill stability and slope armoring. In other words, overtopping analysis should be considered the first step in hazard analysis, with more detailed, site specific investigation followed by an assessment of the potential downstream effects of failure and the value of the potentially affected aquatic habitat.

It is evident from condition surveys that a large number of the culverts within the watershed analysis area are functioning below optimum hydraulic capacity. This is the result of inlet plugging, inlet damage, or structural deficiencies such as seam separation, deformation or decomposition.

A complete copy of the hydraulic analyses for Oakridge and Rigdon District's FY-95/96 timber sale program is included in Appendix J.

QUESTION 5

Since funding is no longer available to maintain the entire existing road system to designated levels, what are the potential resource effects of not maintaining all the roads in this road system?

Since we are in a declining timber program and decreasing budgets in road maintenance we will not be able to maintain the existing system as we have 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 balanced the budget with the maintenance program. This will amount to 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 many of the system roads, making them impassable. Rock fall, tree fall, and slope ravel will close or make access available only by high clearance vehicles. Some loss of the roadway is possible from failed drainage systems.

If roads are not maintained there is a higher probability of culvert and roadbed failures that could introduce sediment into the stream system. Such introduction could silt in spawning gravel's, reducing the spawning success of native trout and potential future salmon and steelhead populations. 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 6

Where and to what extent have roads (especially Aufderheide Drive) affected habitat connectivity and riparian reserves?

Figure 1 of this chapter displays the overlap between road clearings (including road surfaced area and altered roadsides) and riparian reserves. Table 3 of this chapter displays the acres of riparian reserve and percentage of overall riparian reserve included in such road openings. These road surfaces and open areas may pose barriers to movement by the least mobile species, but do not effect the dispersal of more mobile species (including wind blown seeds, spores and other vegetative materials). Table 4 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 adjacent to residential areas where pond turtle migration is not be expected to occur.

Table 3: Riparian Reserve Acres in Road Openings

Sub - watershed	Riparian Reserve Acres in Road Openings	Percent of Total Riparian Reserve Acres in Road Openings
17-1	187.25	2.6
17-2	184.29	2.2
17-3	152.37	2.7
17-4	109.94	2.6
17-5	75.96	1.5

Sub - watershed	Riparian Reserve Acres in Road Openings	Percent of Total Riparian Reserve Acres in Road Openings
24-1	66.12	0.8
24-2	11.00	0.1
24-3	25.61	0.2

There are many impassable culverts in the North Fork Watershed located adjacent to the main stem North Fork as well as higher up on tributary streams. Impassable culverts decrease habitat connectivity for trout and salmon populations. Impassable culverts do not allow the upstream migration of these species to otherwise available spawning areas. In addition, these culverts do not allow for resident trout migration, thus forming genetically isolated populations. It is also known that in small tributary streams with severe 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 to their summer habitat. There have been no studies on resident trout migration in this watershed but there exists a potential for this down-stream winter migration problem to have occurred in the past and to continue to occur in the future. There are many impassable culverts in the North Fork Watershed located adjacent to the main stem North Fork as well as existing high in tributary streams.

Figure: 1a
Roads Within Riparian Reserves

Lower North Fork Middle Fork
Willamette River Watershed

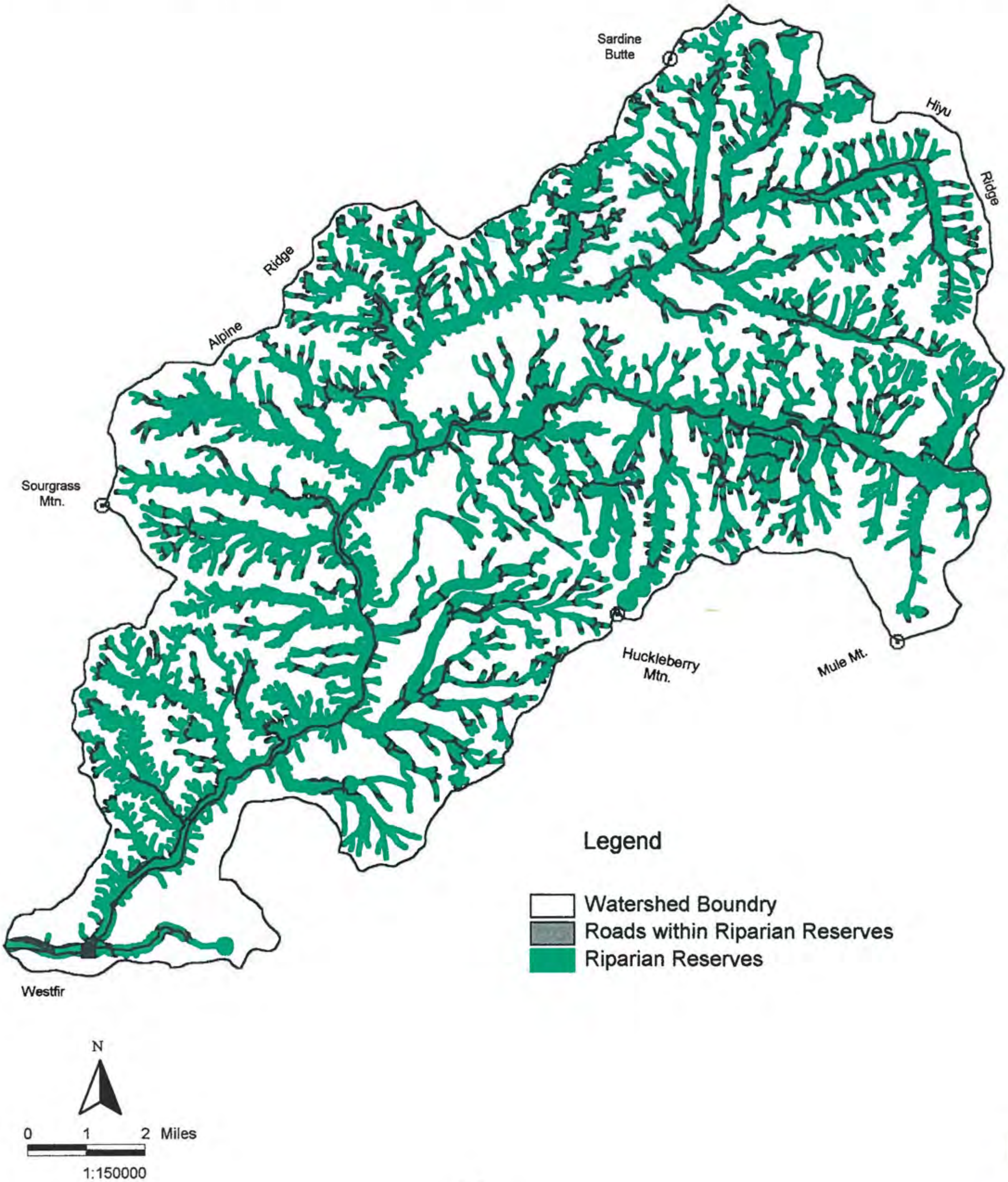
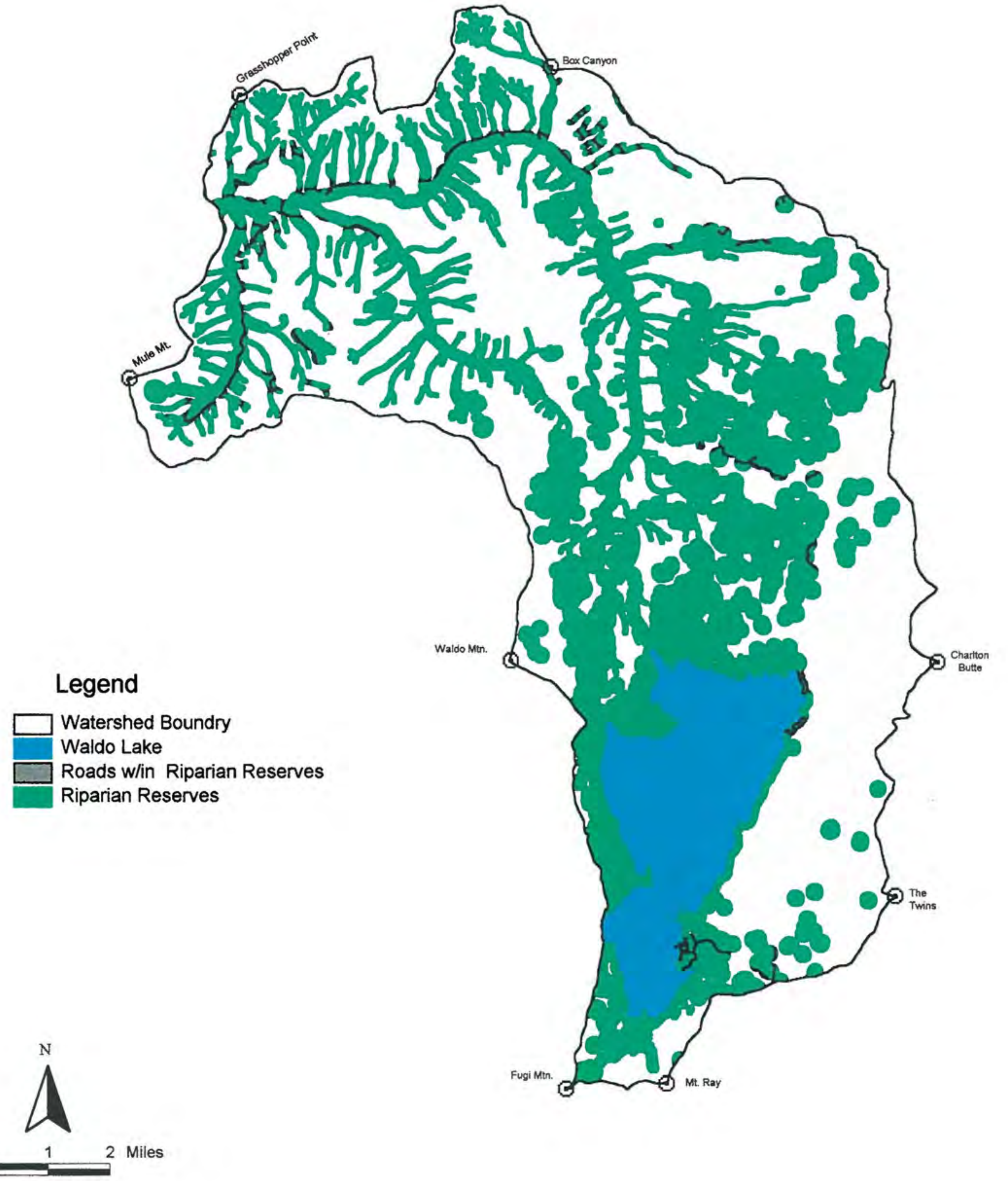


Figure: 1b
Roads Within Riparian Reserves

Upper North Fork Middle Fork
Willamette River Watershed



QUESTION 7

Where and to what extent have roads affected wildlife populations (points to consider: disturbance, poaching, etc.)?

The road density elk habitat effectiveness has decreased over time for the same portions of the watershed in response to intensive road construction which exceeds 3 miles of road per square mile of area in 11 of 19 Big Game Emphasis Areas. Road density is above levels prescribed in the Willamette Land and Resource Management Plan (LRMP) for five Big Game Emphasis Areas as displayed in Table 22 of the Reference/Current Condition chapter.

QUESTION 8

Where and to what extent have roads affected special habitats?

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; and 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 impoundment's, rip rap placed over tall fill slopes, construction of bridges and mine adits. One known site with populations of a sensitive plant species (Rhomanzoffia thompsonii) is transected by a road that appears to be intercepting and diverting water away from the lower section of the meadow.

QUESTION 9

Where and to what extent has the condition and use of trails influenced disturbance (i.e. surface erosion, slope movement, landslides)?

There are no trails that have triggered major slope movement. No existing trails are located in "high risk", slope failure areas. All future planned trails also lay outside of high risk areas, except a potential segment of the North Fork Trail. This trail segment is yet to be constructed and opportunities exist to avoid the area of concern. On steep inclines and where trails cross streams, there is a potential for surface erosion. Trails that do not use bridges at stream crossings will increase local surface erosion, which enters the stream. If erosion is not controlled on steep trail segments, soil is displaced and the trail tread deteriorates, but sediment may not necessarily enter the stream system. It is thought that this potential is low, given the ability of trails to avoid areas with the potential to generate sediment. In any case, trail generated sediment is a very small problem compared to that generated by roads.

QUESTION 10

Where and to what extent are the trails and their use affecting wildlife and botanical values and where and to what extent have wildlife and botanical values affected trail use (via resource protection closures)?

Though the extent of effects of recreational and administrative use on special habitats or threatened, endangered and sensitive species of plants and animals is not well documented at this time, a number of specific cases are known. 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. Some features associated with trails may provide structural habitat (for example bat roosts under bridges or in the roof of shelters or amphibian habitat under boardwalks across wet meadows).

Some segments of trail come close to occupied or potential sites for threatened, endangered or sensitive plant or animal species. Currently trail use in these areas is not restricted. However, seasonal restriction of motorized trail maintenance work has been applied to some segments of trails close to known bald eagle nests. This may also be applied to other areas if peregrine falcon use of potential habitat is confirmed. Based on feedback from 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 bald eagle nest sites and peregrine falcon sites if occupied. The Forest Plan requires Management Plans to be prepared for Bald Eagle Management Areas in addition to consultation with USFWS for any actions potentially affecting these areas.
Though spotted owls are present in the area and are 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.

QUESTION 11

How does changed access influence potential human caused fire ignitions and suppression response time for all fires (change in NFMS results)?

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.

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 format below.

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

South Zone -- Wilderness

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

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 12

How does changed access affect public and administrative use of forest and local economics? (include abandoned trails and historic sites)

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.

It is assumed that road access to administrative sites (i.e. Huckleberry Lookout or Taylor Burn Guard Station) will be maintained in the future. 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.

Paving the Charlton Road (#5897) would increase through traffic, increase and potentially change the recreation use in the Waldo basin and has the potential to redirect traffic, bypassing Crescent Junction businesses on Highway 58.

It is not apparent that closing the Taylor Burn Road (#514) will have any economic effect on businesses in Crescent Junction or Oakridge. People who have used this road over the years would be displaced. This road provides an experience unique to the area. Very few roads on the west side of the mountains present its types of driving challenge and experience; a significant reason why the road has been kept open.

Issue #4

The introduction and spread of non-native species is affecting the native flora and fauna.

ISSUE #4 KEY QUESTIONS

QUESTION 1

Where and to what extent has introduction of non-native species affected native flora and fauna?

Some introduced species have contributed to beneficial effects to native species by contributing to local prey populations that are relatively free of chemical contaminants (such as those contained in the tissue of many neotropical migratory birds). Other species have detrimental effects on native species by competing for habitat and prey resources, or by direct interactions including nest parasitism and predation on native species. Loss of native species can have social and economic effects in terms of entity and medicinal values.

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, with anglers stocking lakes and streams with their favorite fish species occurring 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 eat 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 relative importance of these native non-fish communities varies depending upon social values.

Several non-native plants are now well established in the vegetative communities in the North Fork watershed. Non-native vegetation will continue to be a formidable presence in the landscape. Continuing invasion and establishment will occur, whether from inadvertently traveling in underneath vehicles/equipment or on tires, 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 fire lines often serve as seed beds for noxious weeds. 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 exists.

QUESTION 2

What is the social and economic effect of introduced non-natives?

Some introduced species have contributed to social and economic well being by offering berry picking, sport hunting and fishing opportunities, by enhancing scenic quality, and 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, in some areas, reduction of bird watching opportunities.

The social and economic effects of introduced fish species varies depending upon if social values determine that fishing for natives (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

Need to restore and maintain the habitat for future re-introduction of salmon and bull trout.

ISSUE #5 KEY QUESTIONS

QUESTION 1

What are the potential social, biological, and economic effects of habitat restoration for and re-introduction of salmon?

Placement of stream-wide in-stream structures would affect kayaking and rafting. Partial spans would not have as great an affect, especially during high flows.

If salmon are reintroduced, Visitor Use Days in the drainage are expected to jump dramatically. There is a good chance that people will make use of the communities of Westfir and Oakridge, bringing recreation dollars into the local economy, potentially increasing property values, and contributing the amount and value of ocean salmon fisheries. Previously low and medium use dispersed sites would be expected to receive high use, and opportunities for solitude would be reduced. A new campground by Short Creek is proposed if Kiahanie becomes more well used. A day use picnic area is also planned for Camp Five, should increased use occur. Should salmon be reintroduced, anglers could monopolize interpretive and swimming hole parking areas. This could affect swimmers and visitors using the Scenic Byway.

According to the Wild and Scenic River Plan, no outfitter guide permits connected with boat and related activities will be issued, eliminating a niche for gaining economic benefit. This will force most anglers to fish from the banks (it's a very technical river to boat), which is expected to increase user formed trails and trampling of vegetation.

There are basically three major river users; anglers, boaters, and swimmers. If salmon are re-introduced and prime fishing days overlap with prime swimmer days, there is time before conflict occurs to develop education and outreach programs on proper behavior for each group. The greatest potential for such conflict could occur in late spring and early summer when anglers are fishing for anadromous fish. There could also be a need to close some areas to use if spawning activity would be affected by fishing, swimming, or boating.

If salmon are re-introduced, more intensive water treatment for the City of Westfir may be needed (increased amounts of chlorine) as bacterial counts could increase. Conversely, salmon carcasses in the stream system would provide for higher rates of primary productivity due to the nutrients released into the system, and would provide more prey base to species like the bald eagle and black bear. Salmon carcasses in the upper reaches of the system would probably not affect Westfir's water quality as the aquatic ecosystem would likely capture nutrients before they reach the water intake.

Issue #6

There is a demand for products from forest land (other than timber).

ISSUE #6 KEY QUESTIONS

QUESTION 1

Where are forest products (other than timber) located in the watershed?
Willamette NF ecoplot data was used during this analysis to determine areas in which several commonly requested miscellaneous SFP's could be found in sufficient quantities to collect commercially on a sustainable basis. The ecology plots were not systematically placed, so this information could only be used to make general assumptions about species' distributions. Ecoplots and associated plant associations were identified where cover measured at 35% and greater for vine maple, rhododendron, salal, dwarf Oregon grape, big huckleberry, and beargrass. Mazanita, wild ginger, cascara, and madrone were listed when any measurable cover was given. Willow was plotted at 15% and greater, and sword fern and prince's pine at 20% and greater. Figure 21 of the Reference/Current Condition chapter shows stands containing the plant associations that were identified to harbor potential SFP areas. This same map (Figure 21) also identifies where overlaps between product extraction and LRMP restrictions may occur.

Restrictions for commercial use as given in Forest Plan Amendment No. 23 that occur in the NFMF watershed are: Wilderness (MA1), RNA (MA4), Special Interest Areas (MA5a), Designated Wild and Scenic Rivers (MA6e), Old Growth Groves (MA7), Wildlife Habitat (MA9d), Dispersed Recreation Without Timber Harvest (MA10c/e/f), and Developed Recreation (MA12a/b). No commercial harvest of mushrooms, truffles, lichens, or bryophytes is permitted in Riparian Reserves, and LSRs.

Suction dredging is currently banned within the main stem of the North Fork. This activity, if it is conducted on tributary streams, may result in downstream increases in turbidity.

QUESTION 2

Are there conflicts between this product extraction and meeting land management objectives and where and to what extent is harvest of these products appropriate?

Special Forest Product extraction conflicts with meeting land management objectives are largely mitigated through collection guidelines set forth in the Willamette National Forest Special Forest Products EA (USDA, 1994c).

Recreational suction dredging may have a negative impact on trout and salmon spawning success if the suction dredging occurs at times of the year when eggs are in the gravel and shortly after emergence. Dredging could also affect water quality, the aesthetics associated with the Wild and Scenic river, and water potability for Westfir. At this time, this activity is thought to be rare and/or infrequent and no water quality problems have been observed associated with recreational suction dredging.

Issue #7

There is an existing infrastructure in this watershed that may have an effect on watershed values and processes.

ISSUE #7 KEY QUESTIONS

QUESTION 1

Where are existing infrastructure land uses and where are additional uses likely to occur in the future?

As per the Wild and Scenic River Plan, when use at Kiahanie Campground consistently exceeds 80% occupancy, construction of a second campground, by Short Creek, is proposed. When both reach capacity, Kiahanie is proposed for expansion. A day use picnic area is also proposed, at Camp Five. Locations for the three additional river access parking spots and 10 interpretive stops provided for by the Wild and Scenic River Plan (USDA 1992) will be limited to relatively flat ground.

At this time no additional infrastructure development, other than that discussed above, is foreseen.

QUESTION 2

Do the presence and use of these facilities affect the resources contained in the watershed, including riparian functions and water quality?

Infrastructure facilities need to be reviewed for compliance with standards and guidelines on the Willamette Land and Resource Management Plan, as amended. Potential conflicts between dispersed recreation sites and TE & S wildlife do occur. These conflicts could be addressed through seasonal restriction of a few sites, rehabilitation of some sites, changes in access to those sites, or a combination thereof.

Water source impoundment's (for suppression and road maintenance purposes) which block culverts are migration barriers for resident and anadromous fish. The impacts on salmonid populations vary depending upon the location of these sources. Those occurring high in tributaries to the North Fork are less detrimental than those occurring adjacent to the North Fork since they are less likely to create barriers to migration. Created water source impoundment's may be a benefit where high quality pool habitat is created.

Campground and picnic area are expected to impact 391 acres over 10 years and an additional 38 acres over 50 years (total of 429 acres). Even with use projected to increase along the North Fork to 14,600 RVDs (developed sites) and 45,000 RVDs (dispersed sites) in the first decade (USDA, 1992), it is unlikely it will affect bacteria levels. Although a study done on the Greenwater River, near Seattle, WA, showed a potential relationship between increased human use and increased densities of bacteria, it was based on 45-55 persons per site. The North Fork corridor is predicted to reach a concentration no higher than 4-8 persons per site.

This analysis has found that existing and planned campgrounds and other infrastructure (as discussed in the Forest Management section of Chapter I, under Issue #7 in chapter II, and the Recreation section of Chapter II) are not inconsistent with riparian and terrestrial objectives of the aquatic conservation strategy. This finding is based upon the relatively small areas affected by these sites in relation to the total area of riparian reserves within the watershed. Additionally, the modifications these sites have made to the landscape are not a high deviation from the natural conditions; that is, tree canopies are mostly intact and landforms are minimally modified.

Some vegetation will be destroyed during construction of recreational sites, but hopefully by directing use, people will use those areas, and not other areas.

The presence of Skookum Campground influences use within the Three Sisters Wilderness. When 100 foot camping setbacks from lakes began, use shifted from previous overnight use to day use. Skookum is now used as a base camp for day hikes into the Wilderness. This helped reduce camping impacts around wilderness lakes, and has no known effect on Skookum Creek.

See discussion for Issue 8 question 1, for impacts from North Waldo, Islet, Shadow Bay and Rhododendron Island Campgrounds.

Issue #8

Waldo Lake area access and travel management.

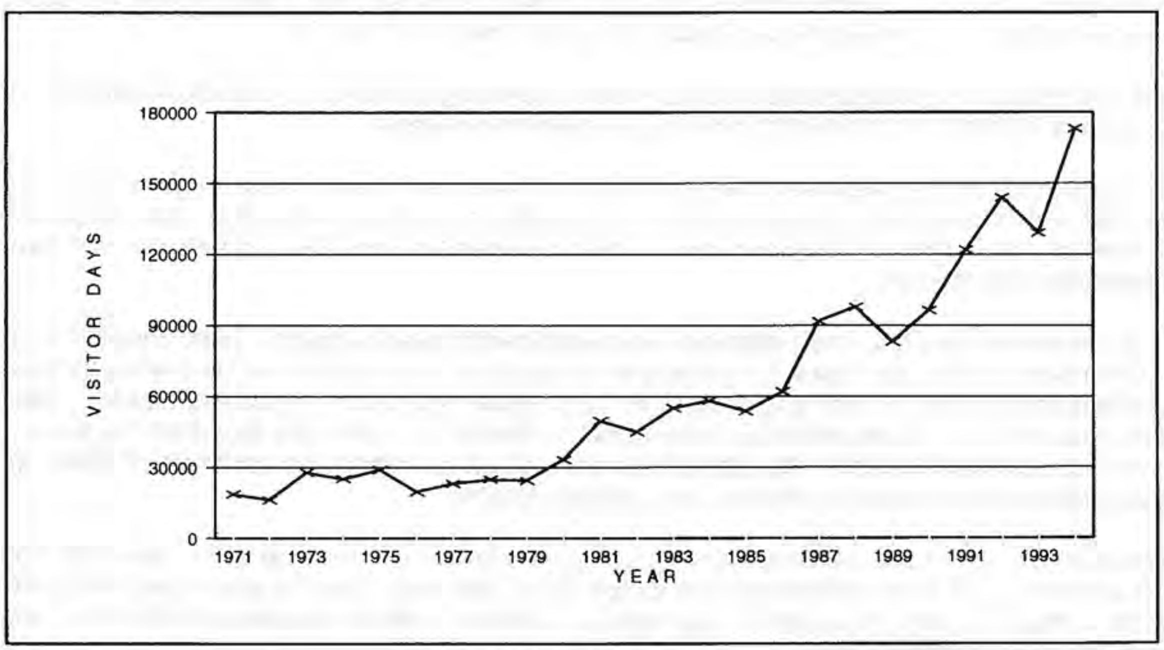
ISSUE #8 KEY QUESTIONS

QUESTION 1

What are the potential impacts from recreation use?

M. emarginata var. aquatica is a Survey and Manage survey strategy 1 and 2 plant species for which site specific management in local planning efforts (Access and Travel Management planning) is of the highest priority. Protection of the known location of this species and conducting additional surveys will improve its chances of viability (USDA/USDI, 1994b).

Figure 2: Waldo Lake Campgrounds Visitor Use Days



The three developed campgrounds at Waldo Lake tend to fill up only during holiday weekends. There has been a 925% increase in visitor-use days (from 18,700 to 173,004) between 1971 and 1994 (see Figure 2 of this chapter). A study of one of ten septic tank drain fields done by the EPA in the early 1970's found no evidence of human effluent reaching the lake. Preliminary analysis of water quality monitoring data from 1969 through 1994 indicates a substantial increase in the Lake's primary productivity over the last five years in terms of phytoplankton densities and also an increase in zooplankton populations (Larson, 1995). Primary productivity increases are caused by increases in dissolved nutrients which are in turn used by phytoplankton. In an oliogotrophic lake such as Waldo, nutrients are quite scarce. Any available nutrients would be taken up quickly by the Lake's biota, so increased nutrient inputs are most readily seen as an increase in living biomass, especially phytoplankton. Phytoplankton is included in the range of particles which affect water clarity and color. Phytoplankton density is thought to be controlled by nutrient availability and/or zooplankton grazing pressure. Therefore, nutrient flux or concentrations, and zooplankton densities may ultimately affect water clarity and color (ODEQ, 1994b).

While causal mechanisms for the above increases in primary productivity are unknown at this point, the increase coincides with a significant increase in recreational use of the Lake and it's basin. It has also been speculated that the introduction of fish may have influenced this increase in primary productivity by introducing additional nutrients in the form of organic material. Continued increases in primary productivity are of concern since increases in phytoplankton can ultimately affect the Lake's ultra-oliogotrophic state as evidenced by the Lake's clarity and color, which lend it great aesthetic value (ODEQ, 1994b).

As the number of visitors to the Waldo Lake area grows in the future, the ten comfort stations located in developed campgrounds adjacent to Waldo Lake have the potential to fail and result in adverse impacts on water quality in the lake.

Other potential sources of pollution include petroleum products washed from the surface of the three existing boat ramps and fuel spills from gasoline powered boats. In addition, sediment from roadside ditches and heavily used recreation sites located on the lake shore have the potential to be sediment source areas as this material is washed into the lake during high intensity storm events or during the seasonal snowmelt period. Currently there is no documented evidence that water quality conditions within the lake are being adversely affected by anthropogenic sources of polution.

No research has been done to determine if human waste is entering Waldo Lake from dispersed sites on islands or from pit toilets in campgrounds, including Rhododendron Island.

The more popular of the 44 dispersed sites on Waldo's shores and islands show impacts from use. Vegetation has been destroyed by escaped campfires, trampled or otherwise damaged. Soil compaction is common in core site areas. Abandoned trash at sites changes the recreation experience, and invite the accumulation of more trash.

Campers in developed and dispersed sites get along with neighboring campers. Most conflicts occur regarding the noise motor boats make. Some people who camp or boat without motors feel motor noise is intrusive and undesirable (including comments on 1994 Wilderness visitor registration cards). Some people feel motors cause water pollution, some object to the noise, and some also find the smell of gasoline and exhaust objectionable. As both motorized and non-motorized use continues to climb, the conflicts surrounding motor use will continue, and probably escalate.

One potential impact from Lake-centered recreation is accidental fuel or chemical spills, especially from motorized activities. Due to the extremely pure nature of the lake water and the long replacement time for the water in the Lake, there is a concern that spills, or continuous small insertions of pollutants, could compromise the purity of Waldo Lake.

One overriding consideration when discussing potential water quality impacts for Waldo Lake is its sensitivity to change. Because of its low buffering capacity (Maleug et al., 1972; Lider et al., 1980, Carter et al., 1966; and Larson and Donaldson, 1970) and long water volume replacement period, (Johnson et al., 1985), any changes in water chemistry and/or trophic status could last for some time, even after existing and/or potential pollution sources are corrected.

The effects, if any, of recreational use on bald eagles nesting at Waldo Lake and in the basin have not been studied. Little is known of the nesting success of two known nest sites in the area, but successful reproduction has not been confirmed. How the eagles of the area react to a variety of recreational users in direct proximity to their nests (including hiking, horseback riding, fishing, boating, mountain biking, camping and snowmobiling) is unknown. The critical period for disturbance to nesting bald eagles is considered to be from a month prior to nest initiation and through incubation (January through April). Rearing of young continues through May and fledging should occur between mid June and late August. The Forest Plan requires measures to reduce disturbance for nesting bald eagles within a primary zone of approximately 125 acres, with specific restrictions for the critical area within 660 feet of known nests. Two trail segments, some dispersed sites and popular fishing areas on two lakes are potentially within 660 feet of these nests. Potential use of the Shadow Bay facilities and over snow travel areas on and east of Waldo Lake Road could occur during the nest initiation and incubation period for bald eagles. Motorized activity usually does not occur within 1 mile of the nest site. The effect of human activity, motorized or not, on eagles during nest initiation and incubation in and around Shadow Bay is not known.

Though potential habitat is present in the area for peregrine falcons, occupancy has not been observed. The area with the highest potential is relatively remote and is not accessed by existing trails, thus potential for adverse impacts to falcons by recreational use of existing facilities is low.

Though wolverines are present in the Waldo Basin area, existing recreational activity probably has little or no effect on use of the area by wolverine. This is due to the presence of extensive remote areas, including the wilderness area, limitations on accessibility to most of the area from early winter through late spring or early summer, and recreational use being concentrated on a few trail corridors. Opening of the area east of Waldo Road, north of Bobby Lake trail and south of Charlton Lake to over-snow travel should not affect wolverine due to the presence of adjoining large tracts of area closed to oversnow travel, and the large home range size typical of wolverine. Also, due to the relatively extreme snow conditions in this area, low use levels are predicted if this areas was opened to snowmobile use.

QUESTION 2

What opportunities exist to better provide for a range of quality recreational experiences with lesser amounts of user conflict?

Summer -

Much of the Waldo Lake trail passes next to, or through, dispersed sites. Unknown people passing through sites tend to upset users of those sites who may fear theft or simply react to a reduction in their perception of solitude.

If current stretches of Waldo trail remain away from the shoreline, the solitude available to dispersed campers, trail users, and boaters would be maintained. Conversely, trail placement can be a management tool to decrease the desirability of some dispersed sites on the lake shore.

All new facility construction or reconstruction has the opportunity to include access to natural settings for users with disabilities.

Over the last 23 years campground use has increased by 925 percent. This suggests that trail use may also have increased by a similar amount. Use of trails by mountain bikes increased in popularity about five years ago. Opportunities exist to reduce or prevent conflicts between traditional trail users and this new use through education on trail etiquette.

Because the Harralson Horse Camp does not have a water source, there is an opportunity to prevent friction between horse and non-horse campers by providing a water source at the Harralson camp, or to provide a horse camp at another location far from other developed sites where water is available.

Removal or restriction of motor boat use on Waldo Lake would reduce or eliminate the conflict between those who find motor noise disruptive and intrusive (restriction could include electric engines only, or motorized use in designated areas of the lake). Elimination of internal combustion motors from Waldo Lake could provide a lake-oriented recreational experience for non-motorized boaters unparalleled in Oregon. However, such an action would reduce access to Waldo Lake for those wishing to use internal combustion motor boats.

Winter -
Use of snowmobiles east of a portion of road 5897 under specific conditions (greater than two feet of snow) offers local residents a nearby, challenging recreation experience. Opening the area north of Bobby Lake Trail has a low probability of having skier/snowmobiler encounters. Use of Road #5897 where it turns east (known as the Charlton Road) as the northern boundary for over-the-snow use, would protect the Charlton Butte Research Natural Area from potential effects of snowmobiles. However, this area is designated Semiprimitive Non-Motorized in the Forest Plan. Major snowmobile areas to the North (Bachelor), East (Crescent and Paulina) and South (Diamond Lake) all allow over-the-snow use. These areas are all immediately adjacent to the Deschutes National Forest.

Most snowmobilers are attracted to places offering gas and food and trail connections to similar areas. Many non-local snowmobilers prefer the Crescent Junction area, which offers dry snow, and groomed trials that connect to other popular snowmobiling areas. The snow park for the Waldo road is small and uneven and is used mainly by locals. If the Forest Service improves or expands this parking area, non-local use will not necessarily significantly increase. Local snowmobilers currently complain about the restriction to one travel corridor. Increasing use within the existing narrow corridor may exasperate the situation and increase violations of over-the-snow use.

QUESTION 3

What motorized and non-motorized boating opportunities exist within the immediate surrounding area?

The only lake with the size and clarity of Waldo is Crater Lake. The National Park Service prohibits public boating on Crater Lake. Only Park research vessels and a concessionaire craft are allowed, and they are motorized.

Almost all Oregon lakes in mountainous settings (outside of Wilderness areas) allow motorized use. If there are restrictions they are usually speed related. All the larger lakes close to Waldo allow motors (Crescent, Odell, Davis, Hills Creek, Crane Prairie, Wickiup and Summit). All of the larger, popular lakes around the state are motorized (Diamond, Lemolo, Detroit, East, Paulina, Timothy, Howard Prairie, Applegate, Lake of the Woods, Hills Creek, Lookout Point, Fern Ridge, Fall Creek, Foster, Green Peter, and Wallowa). Waldo Lake has a 10 mph speed restriction. Of the above mentioned lakes, seven and one half have 10 mph speed limits (Wickiup has portions under the 10 mph regulation). The rest have higher, or unrestricted speed limits. Private boating is not permitted on Crater Lake, which is the closest to Waldo in size and water quality.

Most non-motorized lakes are small and shallow and do not offer the same boating experience as a larger body of water. There are two small lakes close to Waldo, Gold and Hosmer, that are non-motorized. These lakes do not provide the same kind of recreation experience for non-motorized boat use that Waldo Lake could provide due to their small size.

QUESTION 4

What is the need for emergency and administrative access?

Emergency access to the west side of the Lake is required infrequently in fire suppression situations or to rescue boaters with mechanical or other problems. The changeable nature of the weather at Waldo Lake, the large size of the Lake, and the potential need for emergency rescue work is one rationale often presented for the use of motors. These conditions exist even more significantly in other areas that restrict the use of motors (specifically the Boundary Waters Canoe Area in Minnesota and Yellowstone Lake in Wyoming), apparently without any significant problems.

Administrative use on Waldo has historically been low; cleaning and checking use on dispersed sites; checks on fishing and boating regulations; medical and fire emergencies. If public use of boat motors were to be restricted, administrative use, aside that needed during emergency situations, could be efficiently provided by boats without internal combustion motors.

RECOMMENDATIONS

CHAPTER V

RECOMMENDATIONS

Introduction

The following recommendations are made "to identify those management activities that could move the system towards reference conditions or management objectives, as appropriate" (USDA, USDI, 1995, pg. 41). The recommendations are based upon the analysis synthesis presented in the preceding Integration Chapter. While a summarization of the rationale is presented with each specific recommendation, a review of the discussions interpreting the analyses for each issue statement (Chapter IV) will assist in a full understanding of the rational behind these recommendations.

In many cases not enough site specific data or relevant studies exist to absolutely quantify the full ramification of the current conditions. In the face of this incomplete information, the watershed analysis team, in an interdisciplinary process, has relied upon known resource problems and professional judgment to generate these recommendations which in many cases are conceptual in nature.

Issue #1

Intensity and pattern of vegetation manipulation related activities.

RIPARIAN RESERVE WIDTHS

One of the primary reasons for this watershed analysis was to determine whether prescribed interim riparian reserve widths can or should be changed (USDA, USDI 1994a, page B-13). Riparian reserves provide dispersal and connective habitat for terrestrial animals and plants as well as protection of aquatic environments. These corridors and connections will in many cases be wider than prescribed due to overlap with special wildlife habitat allocations, supplemental late-successional reserves, green tree retention clumps, and areas unsuitable for timber management. It is recommended that interim widths as stated in the Northwest Forest Plan be maintained. This analysis has found no information indicating the interim widths are excessively wide or too narrow to accomplish the dual objectives of the Aquatic Conservation Strategy and providing for terrestrial habitat connectivity. Due to the scope of this analysis, it is recognized that site-specific project analysis could reveal circumstances that require consideration for modifications to the interim riparian reserve widths. If site-specific project analysis determines a need for deviating from the interim riparian reserve widths, the rationale for these differences must be documented and demonstrate that Aquatic Conservation Strategy objectives and terrestrial habitat connectivity would not be adversely affected.

RIPARIAN RESERVE RESTORATION

It is recommended that riparian reserves in this watershed can best be served, from an aquatic and terrestrial connecting habitat perspective, by an aggressive program of riparian restoration in areas where past clearcut harvest has created large areas of early-successional forests. This restoration should consist of any activities that would speed up the development of late-successional conditions. Such restoration activities could include density control to develop larger stem size and a shade tolerant understory, re-introduction of large woody material and/or other structural elements into channels, reforestation and underplanting, and possibly fertilization.

The area most severely affected in terms of riparian functions and terrestrial connectivity is that area between subwatersheds 17-2 and 17-3 (connecting Christy and Grassy Creeks with areas to the south), but all areas where connectivity has been broken along permanent streams should be considered for restoration work if site-specific analysis shows potential exists to speed up recovery processes.

ACTIVITIES IN RIPARIAN RESERVES

Watershed analysis is also conducted to determine what management activities are appropriate within this Tier 2 Key watershed (USDA, USDI, 1994a, page C-7) and specifically within riparian reserves (USDA, USDI 1994a, pages C-31 and 32). Considering past experience in this and adjacent watersheds, it is recommended that the following activities are generally acceptable within riparian reserves, assuming appropriate, site-specific environmental analysis determines they are consistent with Aquatic Conservation Strategy objectives, Forest Plan Standards and Guidelines, and terrestrial habitat needs. In many cases the following activities are beneficial to the attainment of Aquatic Conservation Strategy Objectives. Those that do not directly benefit are neutral to those objectives.

- Commercial Thinning of Young, Managed Stands

Commercial thinning (usually cutting and removal of trees greater than 6 inches in diameter) is beneficial to riparian reserve objectives if it is shown that thinning will increase the average diameter of the stand, and/or accelerate the development of a shade-tolerant understory. Accelerating the diameter growth of riparian stands will assist in creation of late-successional conditions sooner and provide for a faster development of large woody material sources for in-stream and terrestrial habitat. See Appendix K for a more in-depth discussion of the detriments and benefits of thinning.

- Young Stand Density Management

Precommercial thinning (cutting trees less than 6 inches in diameter and leaving them on-site) has the same future advantages as commercial thinning.

- Planting and Underplanting

The establishment of forest cover and the re-establishment of shade tolerant understories in otherwise undiverse young stands have obvious advantages to future riparian habitat.

- Collection of Regenerative Materials (seed, scions, cuttings, etc.)

Seed material and cuttings are collected and used for general reforestation and riparian area revegetation. Removal of this kind of material in a well-vegetated riparian zone will have little influence on the amount of vegetation within riparian zones. Seed without the proper, early successional environment may not germinate or seedlings will not survive and cut shrubs will vigorously resprout. Collection of such material can have high off-site benefits to riparian zones and upland areas needing revegetation. Such collections should have a neutral effect on the riparian zone experiencing the collection, given that this material is annually renewed and that collection would be done prudently leaving a substantial percentage of the vegetation in place.

- Collection of Special Forest Products

Commercial harvesting of berries and conifer boughs is considered neutral to riparian resources since these collections do not remove the associated plants, and involved the harvest of material that is annually renewable and since collection would be done prudently leaving a substantial percentage of the vegetation in place.

- Road-Side Brushing

The cutting of road-side brush to provide for better visibility and a wide enough passage for vehicles occurs only within the road prism. It would occur in areas where decisions have been made to keep the roads open for a variety of resource, administrative, and recreational reasons. Road-side brush cutting would have a neutral effect on riparian systems since the presence of the road itself has a much more profound effect and generally would affect a small percentage of any stream reach.

- Wildlife Tree Creation or Enhancement

The killing or topping of green trees to create dead and defective tree habitat in areas that are currently deficient in this habitat structure has a beneficial effect on riparian objectives. It creates a more diverse forest structure and will generate large woody material for in-stream and terrestrial habitat faster than would natural processes.

- Improving Aquatic Habitat (i.e., large woody material or other structural placement in stream channels)

While there could be some short-term negative effects due to sediment production and damaging of small amounts of riparian vegetation, introduction of various channel structural elements in stream reaches currently deficient in large woody material (due to floods or past management) would have long-term benefits to the complexity and productivity of in-channel habitat for fish and other wildlife species, as well as improving bank stability. Habitat improvement projects should be based upon a limiting factor analysis. Habitat improvements would be prioritized by protecting and improving habitat in areas where high quality habitat and healthy fish populations exist and storm proofing areas expected to affect these areas. Habitat that is currently badly degraded would be a lower priority. A more project specific analysis is needed to determine which areas have highest priority.

- Browse Enhancement or Release of Trees

Cutting of brush for forage generation or to release sapling trees occurs in young, managed stands that have yet to close their tree canopy. This activity could have negative effects if it occurs on channel edges but this activity is never proposed close enough to stream channels to affect channel shade. This activity has a neutral effect on riparian objectives, and tree release can have long-term benefits if that activity accelerates the development of a diverse coniferous forest.

- Fertilization (as long as there is no direct application to water surfaces)

Fertilization benefits riparian area function to the extent that it accelerates the growth and development of a diverse conifer stand. It also may increase the productivity of the stream system by generating increases in energy and nutrients that enter the stream through litter-fall. Fertilization is not recommended within stream channels, or within wetlands and wetland buffers.

- Provision of Recreational Opportunities (trails, campgrounds, river and lake access, viewpoints, dispersed sites)

Current recreational sites and facilities often contain areas of bare soil and comparatively low vegetation density. These sites are almost always on flat or at least stable ground that is relatively resistant to erosion. Since the bare areas are relatively few and far between, the current number and use level of these sites and facilities have a neutral effect on the function of riparian systems.

- Creation and Maintenance of Water Sources

Creation of sites for pumping water to supply fire suppression and road maintenance water needs can be detrimental to riparian connectivity and fish passage if improperly designed and placed. If properly designed, placed, used, and maintained, they can increase the diversity of the riparian habitat by creating deep pools where none existed before. These facilities can be beneficial or neutral where their creation is designed with appropriate analysis.

- Creation of Skyline Corridors if Needed to Avoid Construction of Excessive Amounts of Road

Road construction is often the largest source of sediment. It may sometimes be preferable to move logs across riparian zones to avoid the need to construct road to access landing sites providing for yarding away from streams. Though skyline corridor clearing may increase the amount of solar radiation entering a riparian zone, the effect is short-lived as narrow canopy gaps can close fairly quickly. Skyline corridors are most compatible with riparian area objectives if properly designed and trade-offs between corridor effects and road construction are evaluated. They may be positive if their creation is to avoid the construction of potentially more damaging roads.

- Use of Individual Trees for Cable Yarding System Tail Holds

Cable yarding tail and guy line anchor points often require the cutting of a tree to provide a secure anchor without the threat of pulling a whole tree over. If in riparian areas, these trees are usually left in place when felled. Since these tail holds usually involve one tree and there a relatively few landing near riparian zones, their effect on riparian functions is negligible and their creation is in most circumstances neutral to riparian values. Since there is value to down trees as well as standing trees, there may be some benefit to riparian resources if down trees are needed to enhance riparian or terrestrial habitat. Additionally, if tail holds in the riparian zone can accomplish full log suspension on adjacent upland areas, there would be a benefit to riparian areas by avoiding adjacent soil disturbance.

- Fuels Treatments (generally hand pile and burn or light underburning)

Reduction of fuels may be prescribed to protect a riparian zone from future fire risk, especially in areas where fuel is generated by thinning. Treatment of such fuel accumulations has the additional advantage of providing for easier travel for large animals, and can be considered beneficial to riparian systems.

- Noxious Weed Treatment

Killing or reduction of noxious weeds, if properly and sensitively done, can have large benefits to riparian systems. Such treatment can avoid supplantation of native species. Certain noxious plants can affect the use of riparian zones by removing favorite foraging plants or by restricting travel (as Himalayan blackberry can).

- Crossing of Streams by New Road Construction

When properly designed and constructed, road crossings may have minimal effect to riparian management objectives, as they affect relatively small portions of the riparian zones. Road construction may be preferable to yarding across streams if acceptable log suspension cannot be achieved from existing roads.

- Culvert and Bridge Maintenance

Cutting of selected trees within 100 feet upstream of large culverts and all bridges is sometimes proposed to protect these structures from debris that could, if large amounts accumulate against trees growing within or between channels, cause a failure of the stream crossing structure. Such cutting can have small negative effects, but prevention of structure failure may have larger, long-term benefits to riparian resources.

- General Upland Activities

Certainly if the above activities are considered to be acceptable (again with appropriate, site-specific environmental analysis) within riparian zones, they are also considered acceptable in upland areas.

REGENERATION HARVEST, ROAD CLOSURE, AND ROAD RESTORATION

HIGH, HAMNER, MCKINLEY, AND CHALK CREEK AREAS

It is recommended that the mid-point ARP levels, as expressed in Appendix E of the Forest Plan, for these four sub-drainage's be increased from 80 percent to 90 percent to minimize potential increases in peak flows. These four sub-drainage's are particularly sensitive to increased peak flows and debris torrent initiation in relation to other sub-drainage's within the watershed. These conditions are all fully discussed in the preceding Reference and Current Condition and Interpretation Chapters.

Given the sensitivity of these drainage's and the existing conditions of the road systems within then, it is also recommended that road restoration needs identified by District WIN surveys should receive the highest priority in these sub-drainage's. In addition, road mileage should be reduced in each of these sub-drainage's by at least 20 percent since road systems tend to intercept sub-surface water and route it more directly to the stream system, further aggravating peak flow increases, and contribute sediment to the system in the process. Specific roads to be closed should be identified by the up-coming Access and Travel Management Plan, in coordination with other resource and administrative needs. This closure should consist of any and all activities needed to assure that water would not be concentrated by the road drainage system such that the road surface or road prism would remain stable (i.e., remove culverts with potential to be plugged; fill, armor, or otherwise stabilize ditches; and stabilize road surfaces with vegetation). Future harvest in these areas should be planned to avoid road construction, and to maximize the length of time a given road system remains in a stabilized state.

The High, Hamner, McKinley, and Chalk Creek drainage's contain soil types with high potentials for erosion and debris torrents. Stream surveys indicate that these streams have the potential to mobilize numerous slumps that are adjacent to the stream channels. Stream densities in these drainage's are high. This, coupled with the deep and erosive soils they contain, the large percentage of these drainage's within the transient snow zone, and the relatively dense existing road network indicates that an increase in peak flows could also lead to increased sediment delivery to stream channels and associated adverse water quality effects. Several large debris torrents have occurred in these drainage's over the last ten years, most notably the Chalk Creek slide in 1986 that disturbed about 3 miles of stream channel in the Chalk Creek drainage and the North Fork and Middle Fork channels between the mouth of Chalk Creek and Lookout Point Reservoir.

Though the high elevation aerial photo reconnaissance discussed in the Geology section of Chapter III did not indicate that debris torrents are particularly common in these areas, the stream surveys did. More thorough ground surveys may need to be done to more accurately identify all areas of past instability.

Due to the above conditions and events, the analysis team's professional judgment is that management has increased, and current management prescriptions may continue to increase, the incidence of slope instability, sediment generation, and channel altering events to the detriment of the water quality values and aquatic habitat conditions. It is possible that continuation of current management intensities may in the long-term preclude the attainment of several Forest Plan (USDA 1990) standards and guidelines for this watershed, specifically those relating to water quality (FW-088, 090, and 093) and maintenance of long-term site productivity (FW-079, 086, and 107). As mentioned in the fire history discussion contained in Chapter I, these drainage's occur in a portion of the watershed that is subject to potentially extreme but very infrequent natural disturbances.

The analysis team is concerned that the frequent, low level disturbances created by current management strategies may have a cumulative effect greater than the natural disturbances this area has been subject to in the past. Unfortunately, not enough data existed at the time of this analysis to determine the pre-management water quality and channel morphology conditions. The scope of this analysis did not allow for a more detailed and quantified investigation of how management has affected the rates of these events, which have certainly occurred prior to management.

An in-depth cumulative effects assessment is recommended for the High, Hamner, McKinley, and Chalk sub-watersheds. In addition, a more in-depth evaluation than was possible during this analysis should be done to identify all past instability events, both naturally occurring and management induced. Such a survey would determine if the above sub-drainage's encompass all sensitive areas and would help determine which roads should be restored or closed. Specifically, stream surveys have not been done in the Leapfrog subdrainage (17C) immediately to the South of High Creek. The Leapfrog area has soil types similar to the other four sub-drainage's and there have been debris torrents observed in this sub-drainage that were not identified during aerial photo reconnaissance. This in-depth evaluation should consist of ground surveys of historic and recent debris torrent activity in addition to stream channel condition surveys. The results of this survey should show whether harvest and road construction have accelerated the incidence of mass soil movement, and/or channel morphology changes in this portion of the watershed. These results would determine if the recommendations made for the above four sub-drainage's should also be applied to the Leapfrog sub-drainage.

REGENERATION HARVESTING, ROAD REHABILITATION, AND ROAD CLOSURE ALL OTHER AREAS

Areas within the timber production land base but outside of the areas discussed above occur on soils and sites generally much more resilient to timber harvest and road construction, and which have few indications of past slope instability events or potential for eminent future events. These areas also occur in portions of the landscape that naturally experience more frequent disturbances than the area west of the lower North Fork channel. It is recommended that continuation of current Forest Plan mid point ARP levels be maintained in all other areas outside of the areas discussed above. Road restoration activities and road closures in the balance of the watershed should occur as needed and determined by an integrated Access and Travel Management Plan, as appropriate, given that the priority for this type of work is higher in the High, Hamner, McKinley, and Chalk sub-drainage's.

THINNING

For the reasons mentioned in Appendix K, in addition to the objective of maximizing timber volume production in matrix lands, thinning of young stands is recommended. As with all other activities, thinning should only occur when site specific exams and stand growth modeling show that thinning would better or more quickly accomplish various stand management objectives such as producing larger stems, more diverse stand structure, or capturing suppression mortality, and when analysis shows that it can be accomplished without significant resource effects.

FUELS MANAGEMENT

It is recommended that prescribed burning be considered in strategic areas, including within the LSRs, to more closely mimic natural processes and to better protect reserves from catastrophic fire. Wildfire was a wide-spread ecosystem process in this area, and extensive portions of the area periodically underburned during times when stand-replacement wildfire occurred. As mentioned in the Chapter II, Characterization discussion of fire history, not enough is known of the extent of underburning in this area to provide specific prescriptions in terms of area per unit of time or location. It is recommended that a more intensive study of underburning be commenced to develop a better idea of how frequently and where prescribed fire should occur. Prescribed fire can be detrimental to late-successional habitat in terms of removing large wood, snags, and shade-tolerant trees but may be beneficial on a landscape level in terms of protection from catastrophic fire and creation of new snags. It is felt that the portion of this watershed treated with prescribed fire in a given decade should not be large.

EROSION

Erosion potential and slope stability should also be considered in determining where green trees, snags, and large woody material are to be retained in harvest areas, in addition to other objectives, such as those for habitat structure and logging feasibility.

COMPACTION

Current management direction has moved away from tractor logging in most cases, so no recommendations will be made. The experimentation with low ground pressure machines, designated travel paths, and other ground based systems (such as cut-to-length yarding, harvester-forwarders, grapple piling with minimal travel) should continue to have an associated monitoring program to determine whether these methods are meeting the Forest Plan Standards and Guidelines (not greater than 20% of activity area in a detrimental soil condition). The same holds true for compaction treatments such as sub-soiling. Amelioration of compaction through sub-soil ripping should be considered in compacted areas if such activities will not affect the health and function of live trees already on the sites.

SLOPE STABILITY

More information is needed, such as the recommended additional ground surveys for the High to Chalk Creeks area, to determine why there was an apparent lack of mass movement response on steep slopes affected by timber harvest or large flood events. If the identification of slope responses found in this current analysis is determined to be representative, there is a learning opportunity available that may lead to a better understanding of the relationship between harvest practices, unit and road location, and slope responses.

SENSITIVE PLANT HABITAT

Continue to identify and classify special habitats during project level planning. Ground truth during field visits to confirm or reclassify SHABS identified during watershed analysis. Analyze SHABS to determine buffer prescriptions to maintain the integrity of SHAB type.

Rare forested stands (plant associations PSME-TSHE/RHMA, ABAM/VAAL/COCA, ABAM-TSHE/RHMA/GASH, and TSHE/RHMA-VAAL/COCA in Hemstrom et. al., 1987) identified in the Willamette National Forest Special Habitat Guide should be evaluated for significance when encountered during harvest project analysis to determine if they need to be included in a Research Natural Area, or otherwise protected from disturbance.

Conduct surveys for C-3 Survey and Manage Species known in the watershed during planning efforts. Consider opportunities to designate special interest areas or areas of critical concern for "hot spots" of biological diversity on a planning area basis.

Other general mitigation measures as outlined in Appendix J2 of the Northwest Forest Plan (USDA/USDI, 1994b) that could be used to benefit survey and manage species include:

- Conduct surveys in high probability habitat and map new sites of candystick plant (Allotropa virgata) and randomly revisit a subset of historic sites to determine presence or absence, past fire history, stand management, collect information on woody debris, canopy closure, plant association and abiotic factors, survey in sites with planned prescribed burning.

- When harvest units greater than 40 acres are proposed, green tree retention clumps should be at least 4 acres in size to provide for the most favorable epiphytic microclimate (See Appendix J2. page 231).

- Select for a diversity of leave tree species, especially those hosting a large variety and abundance of bryophytes and lichens.

Issue #2

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

The various reserve areas in this watershed are important in maintaining diversity and meeting management direction. Fire suppression efforts are critical to maintaining the values of these reserves. Provision of access, establishment of fuel breaks, and providing for quick response to fires may overall be more important than fuels reduction efforts since fuels reduction could change the desired conditions of these late-successional habitat reserves, as mentioned above. Underburning may be acceptable in some areas and unacceptable in others. Protection of younger stands is vital to bring area back to older seral stages. It is recommended that priority road access be maintained in the Late-Successional Reserve (as determined by the ATM planning process), and fuel breaks be established to assure the needed protection, an addition to sensitive treatment of fuels. Creation of fuel breaks should involve treatment of activity generated fuels (such as those from precommercial or commercial thinning) along strategic road locations.

Consider use of prescribed fire, girdling, and selective harvest methods to maintain and/or restore non-forested meadow complexes that are presently being encroached upon by trees.

Use prescribed fire as a tool to encourage germination of fire-dependent species such as woodland milkvetch and branching montia. Monitor burns to determine whether they were successful in releasing these species from the seed bank.

Issue #3

The density and condition of roads and trails has altered the landscape processes.

Road restoration and closure priorities are within the High, Hamner, McKinley, and Chalk sub-drainage's, as discussed previously under Issue #1.

Implement road closures to be in compliance with Forest Plan Big Game Habitat Quality standards in BGEAs:

Christy South	(4 miles)
Huckleberry	(6 miles)
Lowell	(10 miles)
Mossy-Grassy	(18 miles)
Nehi	(19 miles)

The above road closures should be implemented to assist in accomplishing road restoration goals as identified in the WIN surveys, and as determined by the ATM planning process.

An inventory of roads located on steep ground needs to be done with an emphasis on the road system constructed prior to 1980. See the road discussion under Issue #1. Specifically, an inventory of the locations where the outside edge is cracked and settled and an assessment of the viability of the road drainage system assuming minimal maintenance frequency.

An assessment of the need to keep high maintenance roads such as 1925-642 open should be done. The upcoming Access and Travel Management Plan should compare high risk roads (outside edge cracking and fill settlement) with the value of the potentially affected resource, then factor in the social aspect of access. If access is determined to warrant keeping a high risk road open, then money for treatment and maintenance scheduling should be committed.

Since less than 1% of the culverts within the analysis area have been assessed for hydraulic capacity relative to a 100-year flood, this work needs to continue. The District WIN database indicates a number of culverts have diminished hydraulic capacity due to plugging, damage, or deterioration. The WIN information should be used to prioritize culvert restoration work. Culverts with a high likelihood to affect large areas of quality habitat should they fail should be repaired first. Continued analysis along timber sale haul routes will indicate deficient culverts and provide funding opportunities. However, additional emphasis needs to be placed on analysis of culverts in streams identified as having high aquatic habitat value.

Road maintenance scheduling needs to factor in the results of culvert inventories. Specifically, culverts with identified deficiencies that are easily corrected, plugged inlets for example, should be treated as soon as possible.

Review non-system roads and determine if they should be converted to a system road or placed on the trail system. Determine what actions are best taken to protect resources on system roads where there has been a chronic maintenance problem. Maintenance levels have been lowered due to reduced funding. It is recommended that the user or users pay for the maintenance of system roads where Road Management does not have the funds.

Replace or modify culverts that are currently blocking fish passage or compromising habitat connectivity. Generally, tributary stream culverts closest to the main stem North Fork channel that would increase access to the greatest amount of habitat should receive the highest priority for such modification. Review the results of culvert condition surveys to determine the feasibility of developing small contracts for inlet and outlet improvements.

Restore the hydrological regime in the Thompson's mistmaiden meadows below road #19.091. Continue monitoring of this mistmaiden population and extend surveys of adjacent habitat to delineate the extent of populations.

Issue #4

The introduction and spread of non-native species is affecting the native flora and fauna.

Continue noxious weed surveys to identify new invaders and "sleepers" (those that may have the potential for dramatic future spread). Inventory other invasive non-natives at the same time. Continue introduction of biological control agents. Look for opportunities for future introductions.

Recognize that the main travel routes for weeds are roads, and consider every opportunity during the Access and Travel Management Plan analysis to close and decommission roads to allow native species to shade out non-native plants.

Coordinate more closely with right-of-way maintenance crews to ensure scotch broom is cleared along with other vegetation.

Look for opportunities such as using Jobs-in-the-woods crews, YCC crews, etc., to control scotch broom and blackberries in sites that are not well established.

Collect and propagate native species for use on decommissioned roads and other ground disturbing project sites that promote non-native spread. Prioritize higher elevation roads and sites that are not likely to revegetate quickly or shade out weedy species after closing for re-seeding with native herbaceous species. Consider the use of native leguminous species.

Experiment with use of prescribed fire to eradicate noxious weeds, using small test plots.

Study the effects of the introduction of fish into naturally fishless lakes (in coordination with ODFW).

Look at the possibility of controlling brook trout, without negatively affecting other aquatic species, to prepare for a more successful reintroduction of bull trout and salmon.

Issue #5

Need to restore and maintain the habitat for future re-introduction of salmon and bull trout.

Stream habitat improvement projects in the North Fork channel and its fish bearing tributaries should continue in anticipation of the eventual reintroduction of spawning salmon into this watershed.

In areas used by boaters, do not place large woody material or other channel structures that span the width of the North Fork to avoid creating boating hazards.

Bridges to cross tributary streams should continue to be installed as the North Fork trail is constructed. See also the road/stream crossing discussion under Issues # 3 and 4.

Even though suitable bull trout habitat exists in the upper reaches of the North Fork, it is not recommended that bull trout be reintroduced unless reproducing populations of brook trout which currently inhabit these waters can be controlled without detriment to other aquatic species.

Issue #6

There is a demand for products from forest land (other than timber).

Bough cutting should be allowed in riparian reserves except within the Wild and Scenic River corridor and where it is not consistent with current land allocation objectives.

It is recommended that limited cutting of live hardwood species for firewood is acceptable if individual trees for firewood harvest are marked or in some way designated such that all trees on a given area would not be removed. Standing, dead madrone (currently, standing live trees are not to be cut for firewood) can be cut if they are not being used by cavity nesters.

Include opportunities for SFP commercial inventory/collection during planning efforts.

Until further research information is available on Cantharellus species, continue to promote non-destructive harvest methods for mushrooms such as Chantrelles.

If any recreational suction dredging begins to occur it should be closely monitored to determine its effects on salmonoid eggs and young in order to determine how or if potential impacts could be decreased should this activity become more common.

Issue #7

There is an existing infrastructure in this watershed that may have an effect on watershed values and processes.

It is recommended that visibility at the Huckleberry Mountain and Waldo Mountain fire lookouts and be maintained through tree cutting and brush cutback. This would also protect the lookouts from potential damage by forest fire. Brush cutback should also occur at the Taylor Burn guard station to provide for its maintenance.

The nesting success of bald eagles in proximity to campgrounds (primarily those on Waldo Lake) should be monitored to determine how these birds respond to the sorts of disturbances generated by campground use.

All pump chances should be monitored for the presence of T, E, and S species and fish presence before any maintenance or enhancement work is done. Creation of sites for pumping to supply fire suppression and road maintenance water should be designed, placed, used, and maintained to provide for riparian connectivity and fish passage. If properly designed, these facilities can increase the diversity of the riparian habitat by creating deep pools where none existed before.

Issue #8

WALDO LAKE AREA ACCESS AND TRAVEL MANAGEMENT

Due to the sensitive nature (especially due to the long time required for replacement of the Lake's water volume) and unique qualities of Waldo Lake, it is a general recommendation that a conservative approach be taken when making management decisions.

TES AND UNIQUE SPECIES

Once survey protocols are available for Survey and Manage Species, they should be implemented downstream of the Waldo outlet to determine the extent of Marsupella population. Conduct surveys for Marsupella in more remote locations and in other drainage's.

Address Marsupella in the Access and Travel Management Plan under in motorized use and sewage disposal issues.

WATER QUALITY

The water quality of Waldo Lake has been monitored since the late 60s. Recent preliminary analysis of data collected over the last 25 years indicates an increase in primary productivity has occurred within the lake over the last five years (Larson, 1995). Primary productivity increases are associated with an increase in dissolved nutrients. A direct link between increased anthropogenic sources of pollution and changes in water quality or the trophic status of the Lake has not been established.

Over the past 20 years there has been an exponential increase in use of the adjacent campgrounds. The ten septic systems in these campgrounds are approximately 30 years old and have apparently never been maintained other than visual checks. Given the proximity of these systems to the lake shore, and the possibility that poorly processed septic tank effluent could conceivably enter the lake through the water table, it is recommended that an aggressive monitoring program be instituted. The wells drilled by the EPA for ground water testing in the 1970s should be tested again to give an early warning of any potential ground water contamination. The nine other septic systems should also be monitored to determine if they are functioning properly. Sewage processing and disposal options that do not involve drain fields should be evaluated and considered.

A long-term, integrated water quality monitoring plan for Waldo Lake should be developed and implemented. Future monitoring should supplement and complement past monitoring efforts to provide for trend analysis.

MOTOR USE

Despite widely held beliefs that the use of internal combustion motors may have an impact on water quality from oil and gas leaks and/or spills and exhaust deposits in the water surface, monitoring has not indicated water quality degradation as the result of motor use. Monitoring has not yet been done to quantify the presence of hydrocarbon compounds. It is the finding of this analysis that at this time the issue as to whether motors should be allowed on Waldo Lake is a social issue having to do with perceptions of appropriate use and noise disturbance.

Given the world class water purity of this lake, the fact that the lake has a low capacity to buffer any changes to its water chemistry, and the fact that there are virtually no existing opportunities within the

State of Oregon for boating on a large lake designated as non-motorized of any kind let alone one in a forested setting, it is recommended that an alternative restricting the use of internal combustion motors on all or portions of the Lake be addressed in the Access and Travel Management Plan. This alternative needs to address the social and T E and S effects of motor use rather than water quality effects. It is felt that if such an alternative were selected, the restrictions on motor use would not have to apply to emergency or law enforcement needs, but it should apply to general administrative functions.

WINTER USE

It is recommended that the area east of the Waldo Lake road from the Bobby Lake trail to the Charlton cutoff road be allocated to winter-time motorized use after at least two feet of snow has fallen. It is recommended that the area remain non-motorized during the summer. There is little non-motorized winter use in the area east of the Waldo Lake road, and the adjacent portion of the Deschutes National Forest allows use of snowmobiles when the snow pack reaches a minimum depth of two feet. The current Forest Plan changed the allocation of this area from motorized winter use to non-motorized use without a focused, site-specific look at effects. There are a small but enthusiastic number of Oakridge citizens interested in using this area for snowmobiling. If this recommendation is implemented the Forest Plan would be need to be amended.

This recommendation would have no negative effects on the Lake or watershed as a whole. It also would not have negative effects on T E & S species as fully discussed under Issue #8 of the Integration chapter. This change in this area's designations would provide for a more varied and challenging snowmobiling experience while avoiding conflict with Nordic skiers (who tend to use the area immediately north of the Willamette Pass ski area more than this area), would avoid the Charlton Butte RNA, and would provide for more consistency between the Willamette and Deschutes Forest Plans.

ROADS

The small erosion problems associated with the Taylor Burn road are not creating any serious on or off-site resource damage at this time that might justify closing the road. It is recommended, however, that ways to minimize erosion and puddling of water be explored for aesthetic reasons, and to avoid a future where the road just is not driveable. This road was specifically excluded from wilderness designation and offers a recreational experience unique to this area.

It is recommended that the continued use of the Taylor Burn road be addressed in the Access and Travel Management Plan, along with the use of two other system roads (5897.011 and .012) that occur in the semi-primitive, non-motorized allocation east of the Waldo road to determine if there are any reasons to close these roads (there are no resource reasons to do so).

APPENDICES

APPENDICES

APPENDIX A:

Terrestrial Wildlife

Table 1: **WILDLIFE GUILDS OF THE WILLAMETTE NATIONAL FOREST**

Early and Mid Seral Stage Habitat Species Guilds -- preliminary guilding

Common Name	Guild	Common Name	Guild
red fox	TLME	northwestern garter snake	TSME
rough-legged hawk	TLME	racer	TSME
swainson's hawk	TLME	scrub jay	TSME
badger	TMME	western fence lizard	TSME
merlin	TMME	western kingbird	TSME
rosy finch	TMPE	western pocket gopher	TSME
Brewer's sparrow	TSGE	Lincoln's sparrow	TSPE
Tennessee warbler	TSGE	MacGillivray's warbler	TSPE
western terrestrial garter snake	TSGE	Townsend's vole	TSPE
Bewick's wren	TSGEM	golden-crowned sparrow	TSPE
house wren	TSGEM	horned lark	TSPE
western skink	TSGEM	lark sparrow	TSPE
willow flycatcher	TSGEM	lazuli bunting	TSPE
American goldfinch	TSME	mountain bluebird	TSPE
Brewer's blackbird	TSME	night snake	TSPE
California ground squirrel	TSME	orange-crowed warbler	TSPE
California quail	TSME	ring-necked pheasant	TSPE
black-tailed rabbit	TSME	savannah sparrow	TSPE
bushtit	TSME	vesper sparrow	TSPE
calliope hummingbird	TSME	water pipit	TSPE
fox sparrow	TSME	western bluebird	TSPE
gopher snake	TSME	western meadowlark	TSPE
green-tailed towhee	TSME	white-crowned sparrow	TSPE
lesser goldfinch	TSME	white-throated sparrow	TSPE
mountain quail	TSME	wrentit	TSPE
northern shrike	TSME		

Mid and Late Seral Stage Habitat Species Guilds -- preliminary guilding

Common Name	Guild	Common Name	Guild
barred owl	TLML	northern flying squirrel	TSGML
fisher	TLML	red-breasted nuthatch	TSGML
marten	TLML	varied thrush	TSGML
northern goshawk	TLML	western red-backed vole	TSGML
northern spotted owl	TLML	white-breasted nuthatch	TSGML
pileated woodpecker	TLML	white-winged corssbill	TSGML
black-backed woodpecker	TMML	Cordilleran flycatcher	TSPL
northern three-toed woodpecker	TMML	Pacific slopeflycatcher	TSPL
Oregon slender salamander	TSGML	Trowbridge's shrew	TSPL
Townsend's warbler	TSGML	brown creeper	TSPL
Williamson's sapsucker	TSGML	red tree vole	TSPL
hermit warbler	TSGML	shrew-mole	TSPL

Figure: 1b

Historic
Terrestrial Large Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

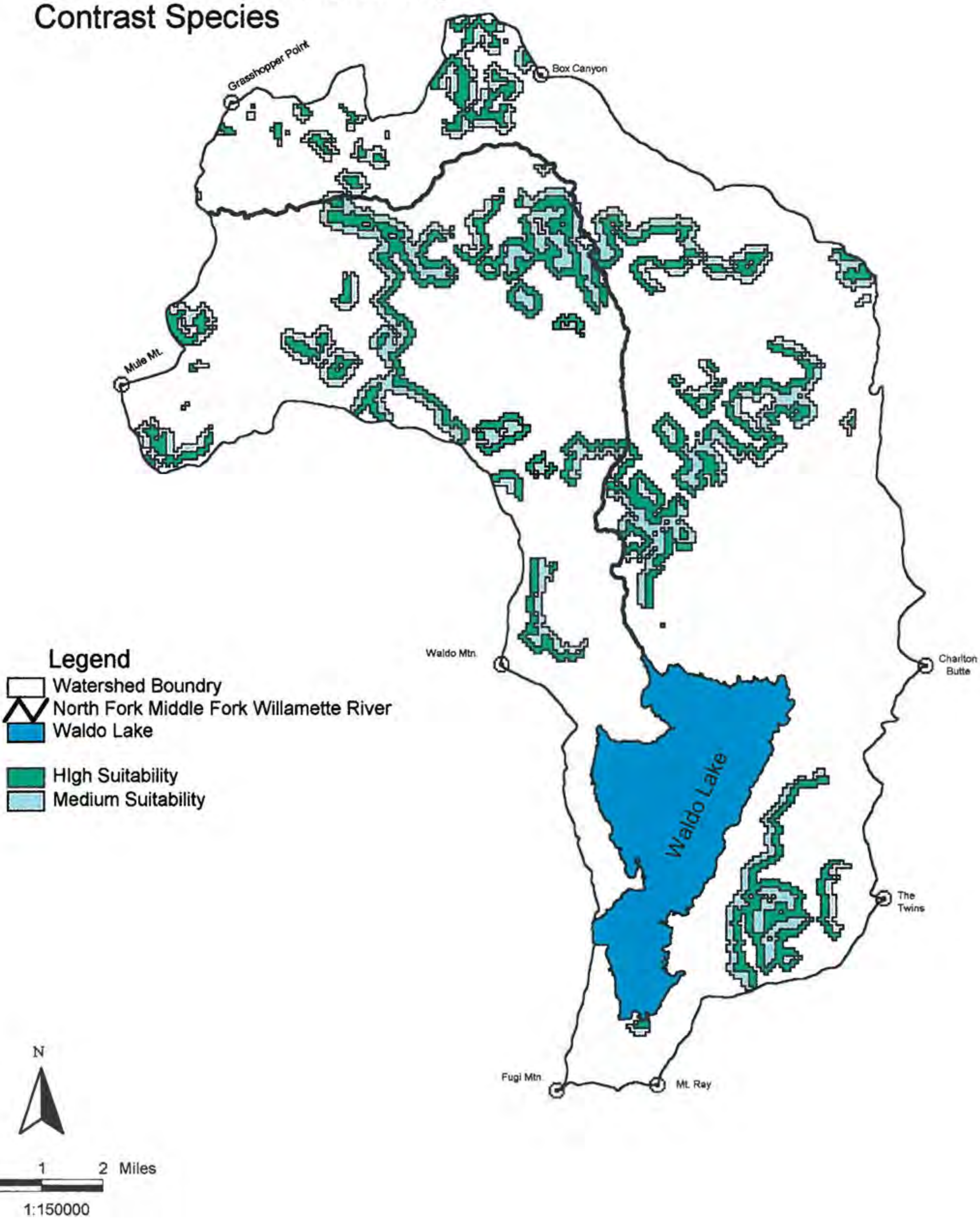


Figure: 2a

Historic

Terrestrial, Medium Home Range

Contrast Species

Lower North Fork Middle Fork Willamette River Watershed

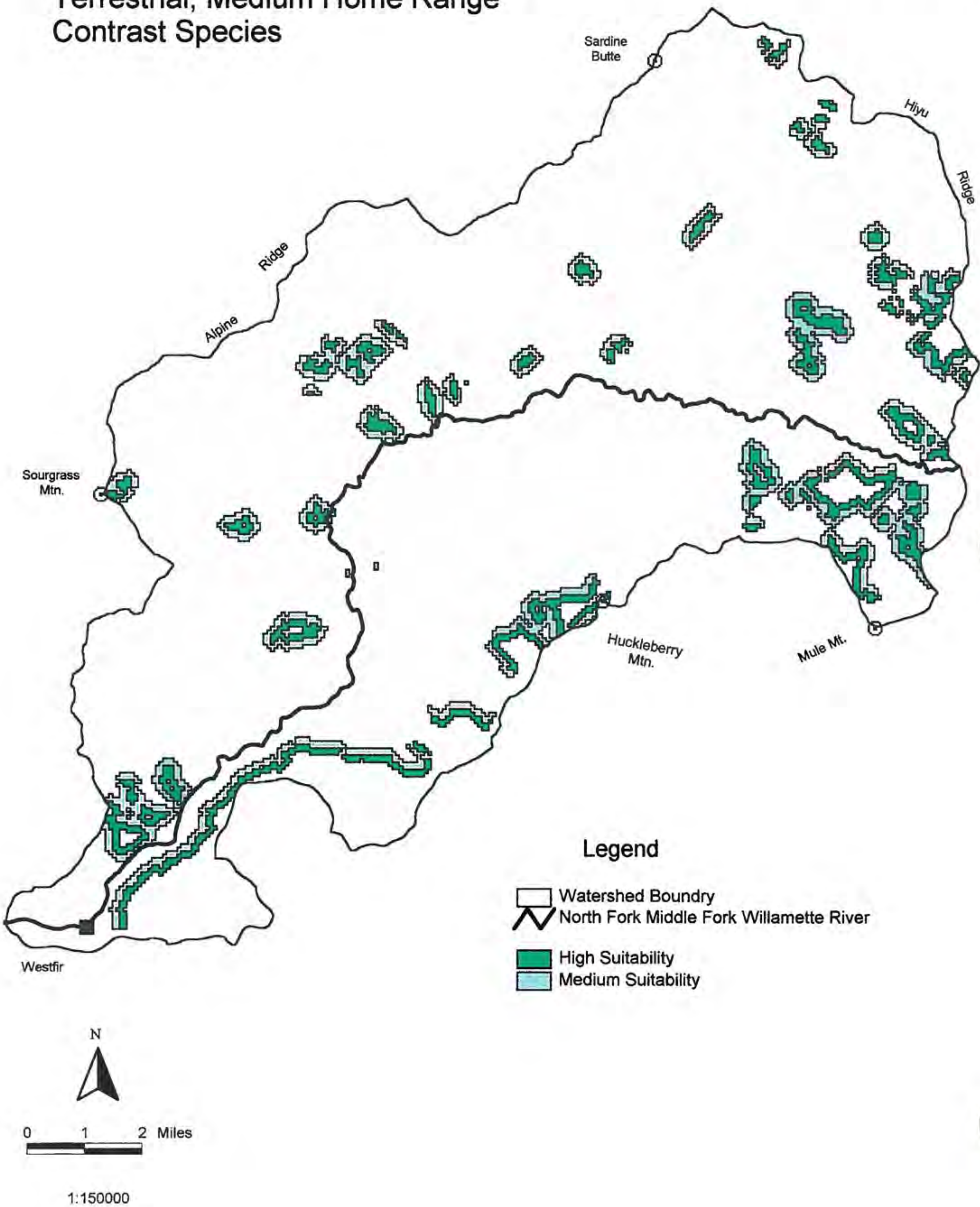


Figure: 2b

Historic
Terrestrial, Medium Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

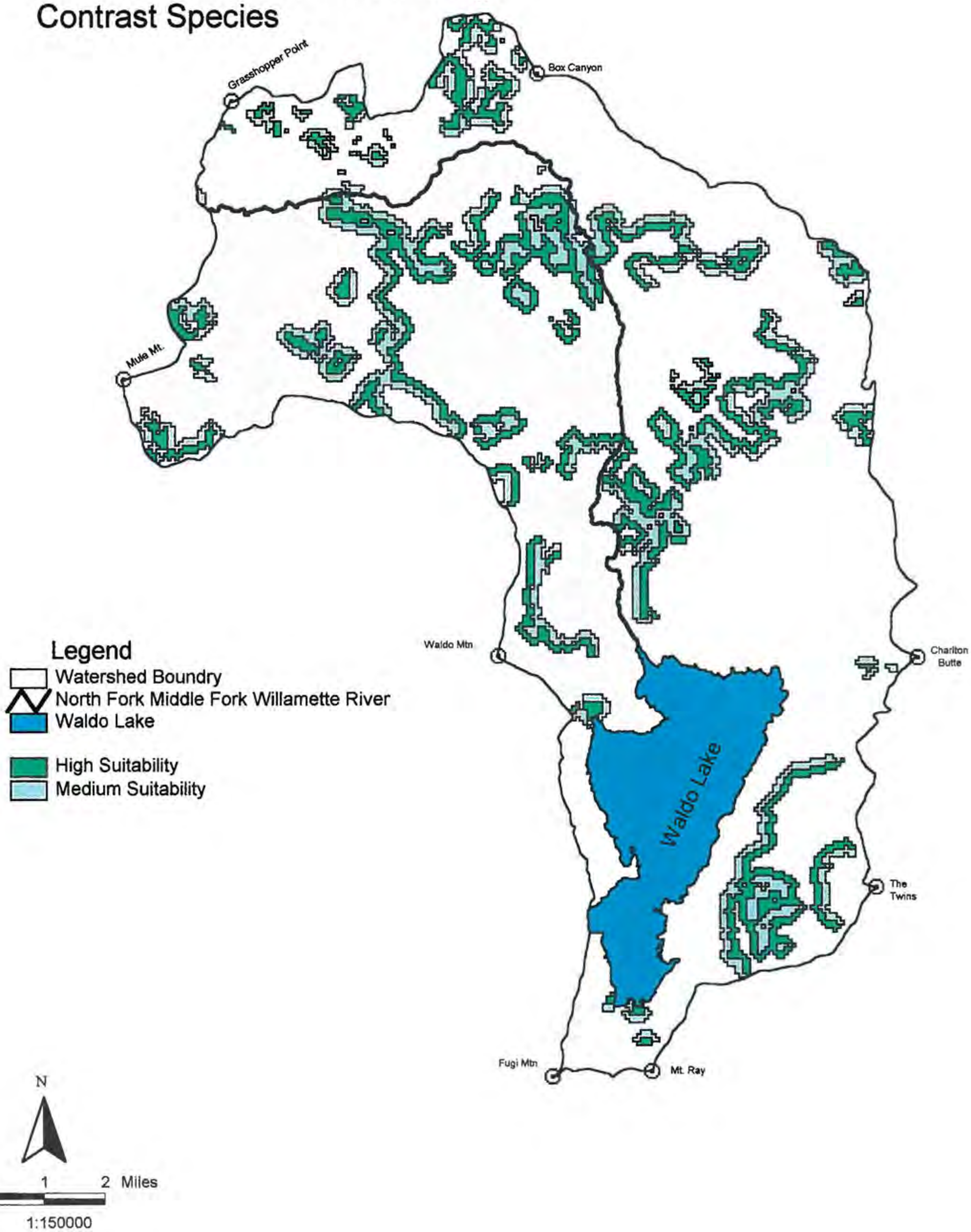


Figure: 3a
Historic
Terrestrial, Small Home Range
Contrast Species

Lower North Fork Middle Fork
Willamette River Watershed

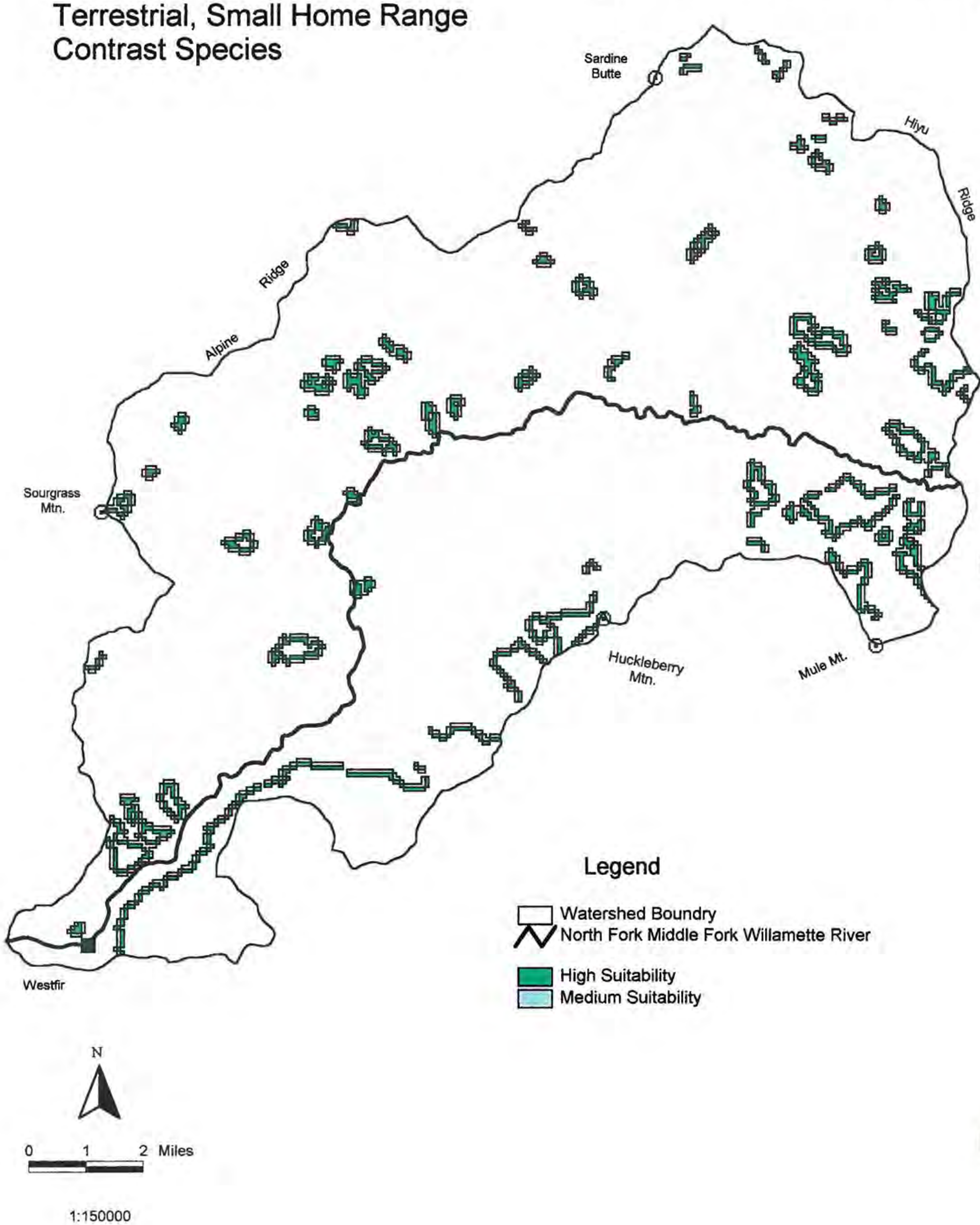


Figure: 3b
Historic
Terrestrial, Small Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

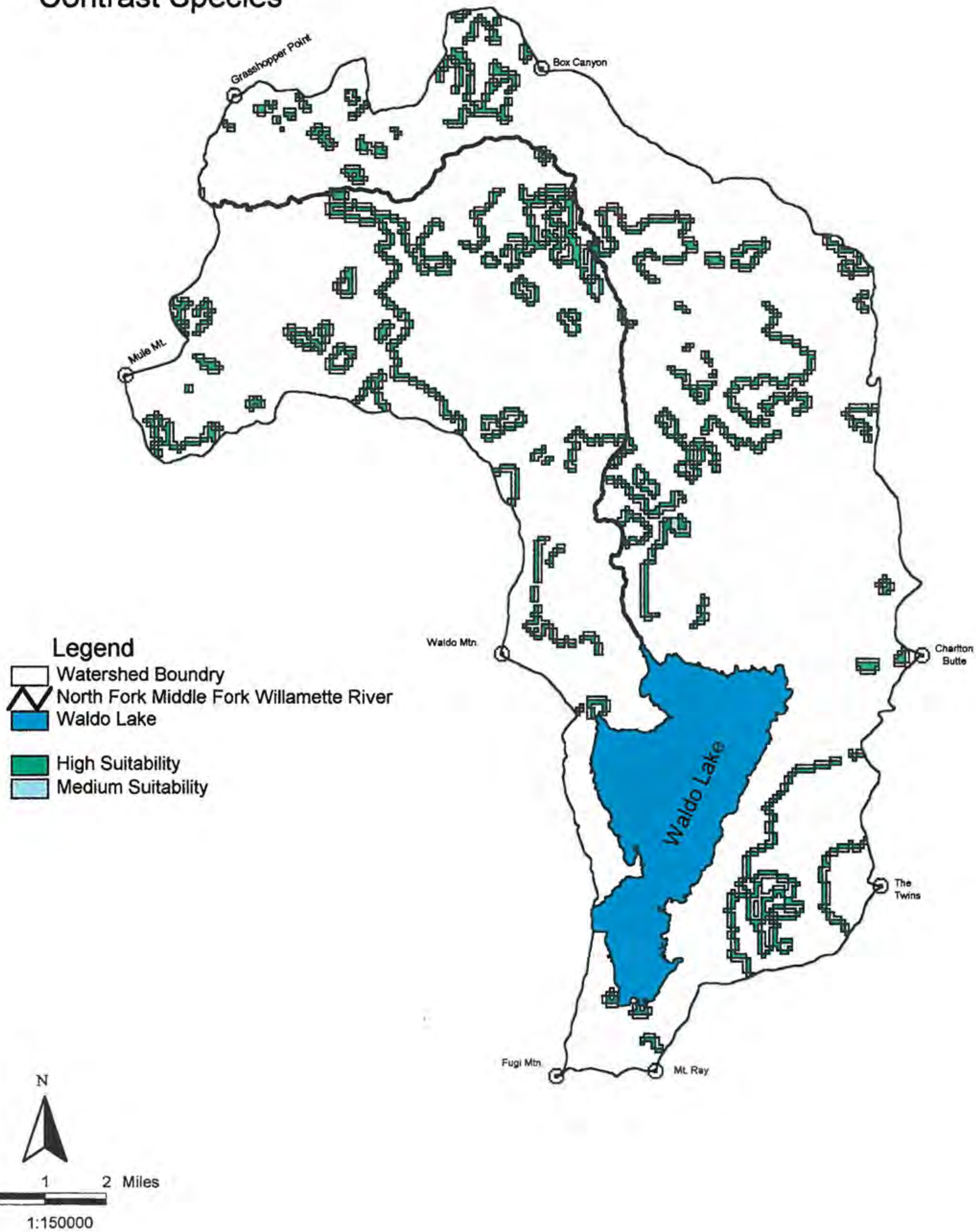


Figure: 4a
Historic
Terrestrial, Large Home Range,
Mosaic, Early Seral

Lower North Fork Middle Fork
Willamette River Watershed

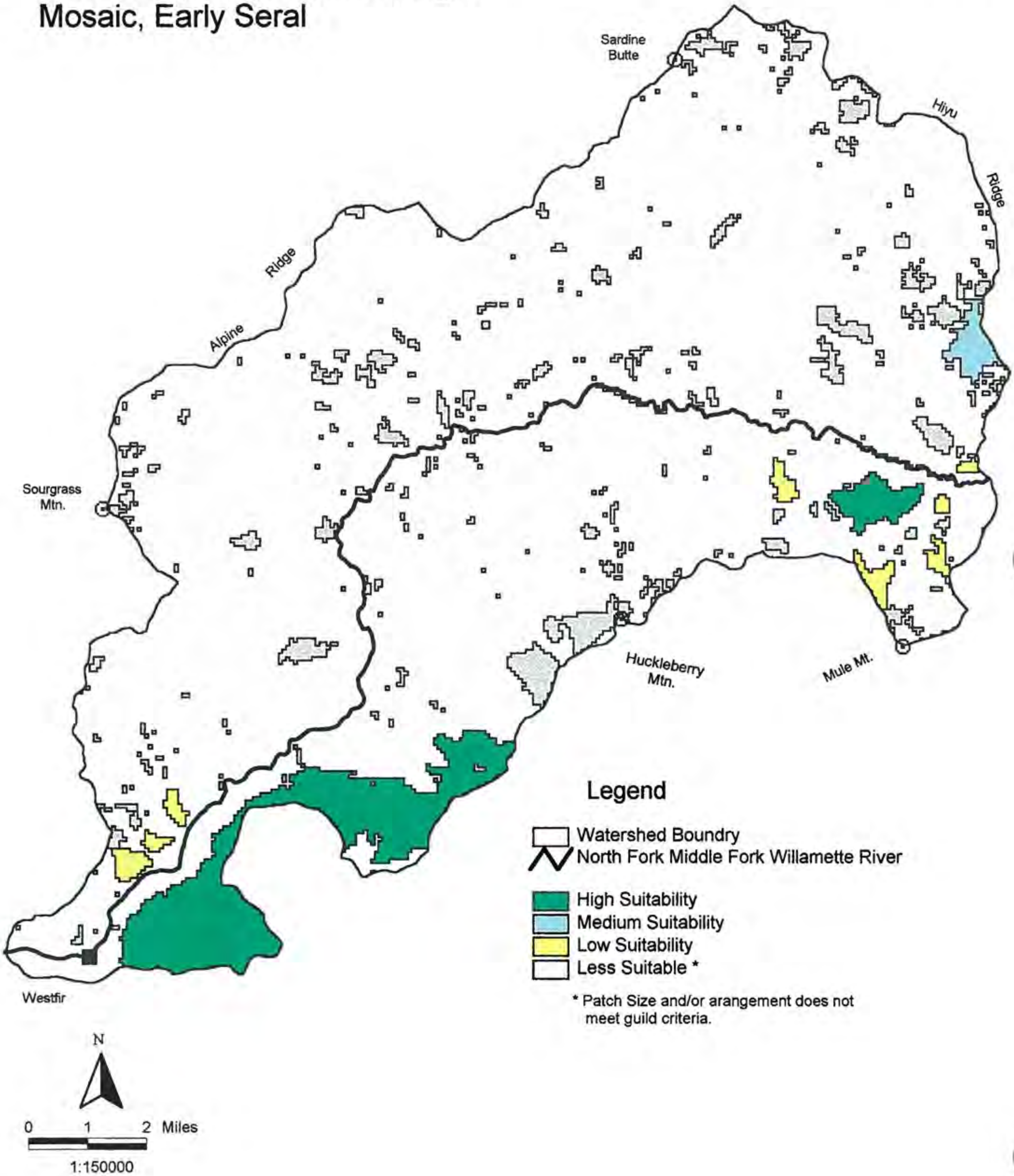


Figure: 4b
Historic
Terrestrial, Large Home Range
Mosaic, Early Seral

Upper North Fork Middle Fork
Willamette River Watershed

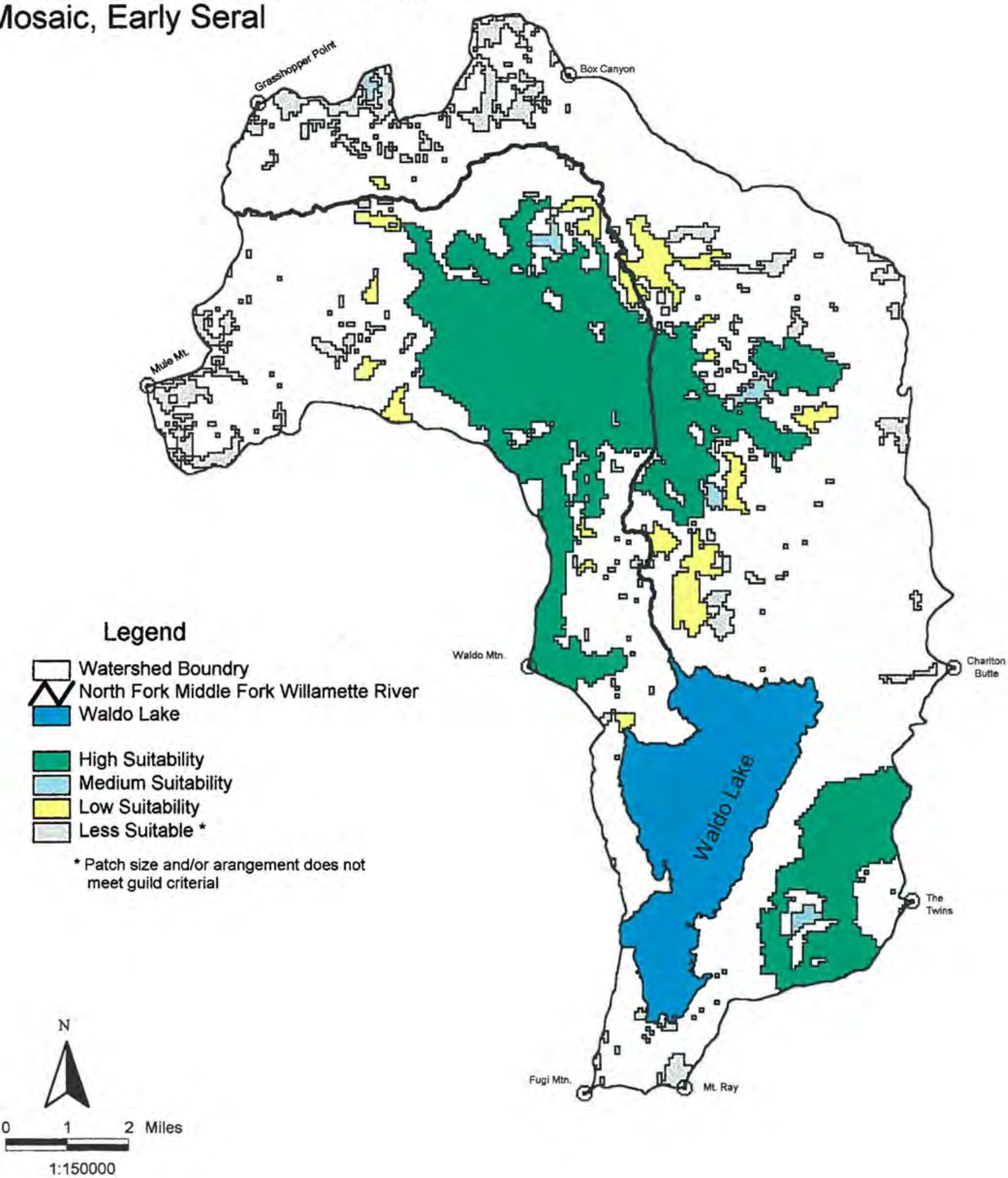


Figure: 5a

Historic

Terrestrial, Medium Home Range,

Mosaic, Early Seral

Lower North Fork Middle Fork Willamette River Watershed

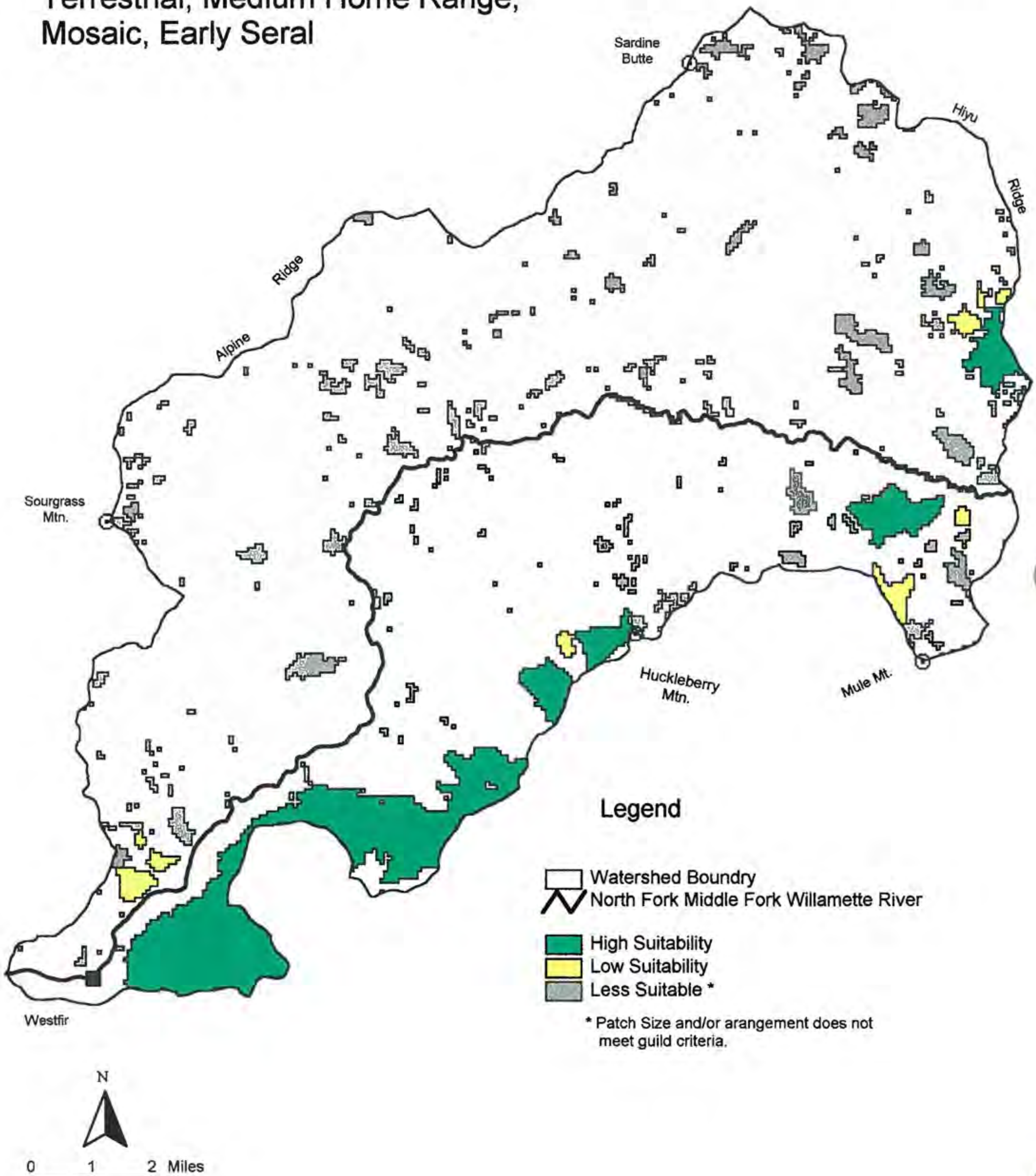


Figure: 5b
Historic
Terrestrial, Medium Home Range
Mosaic, Early Seral

Upper North Fork Middle Fork
Willamette River Watershed

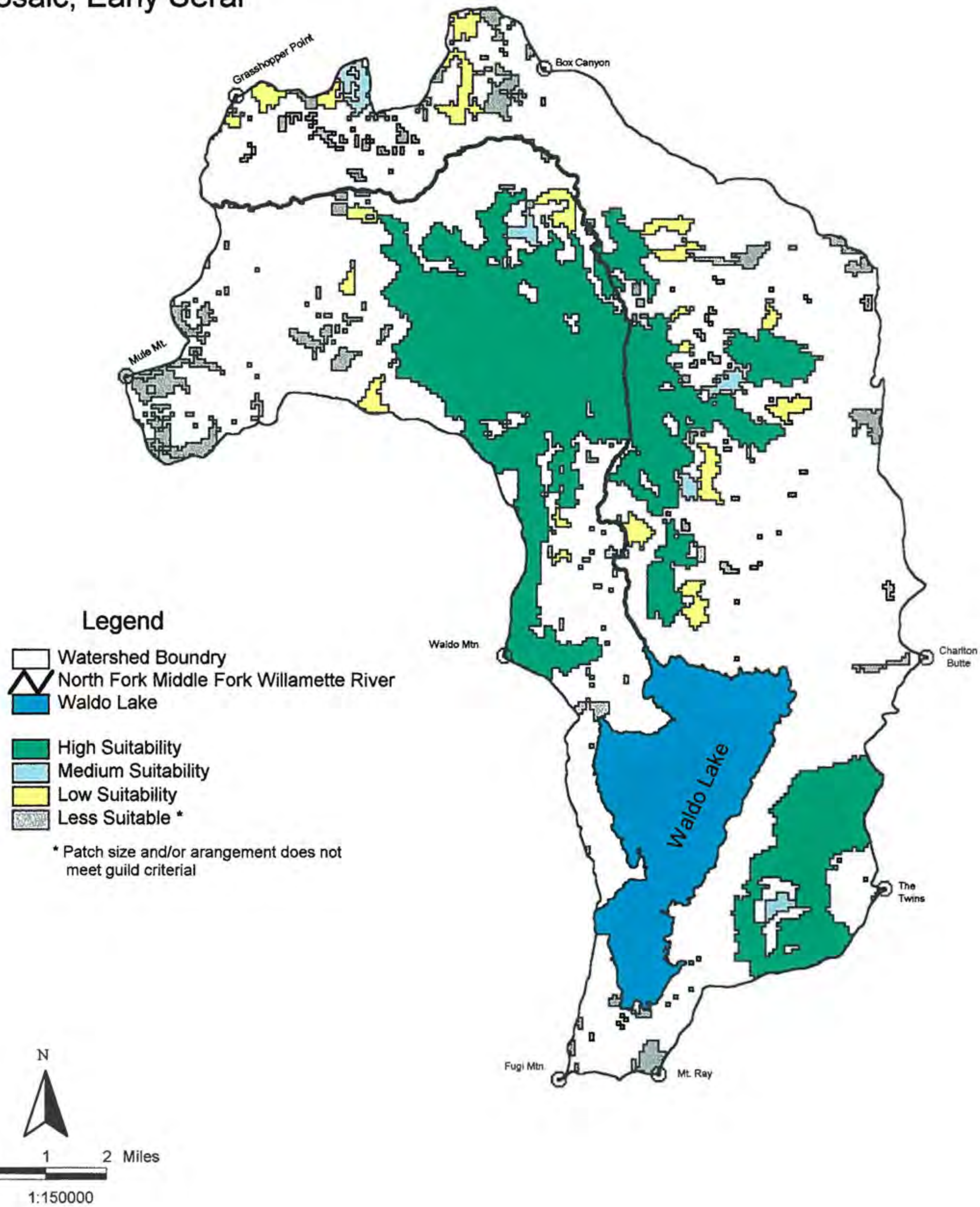


Figure: 6a
Historic
Terrestrial, Small Home Range
Mosaic Early

Lower North Fork Middle Fork Willamette River Watershed

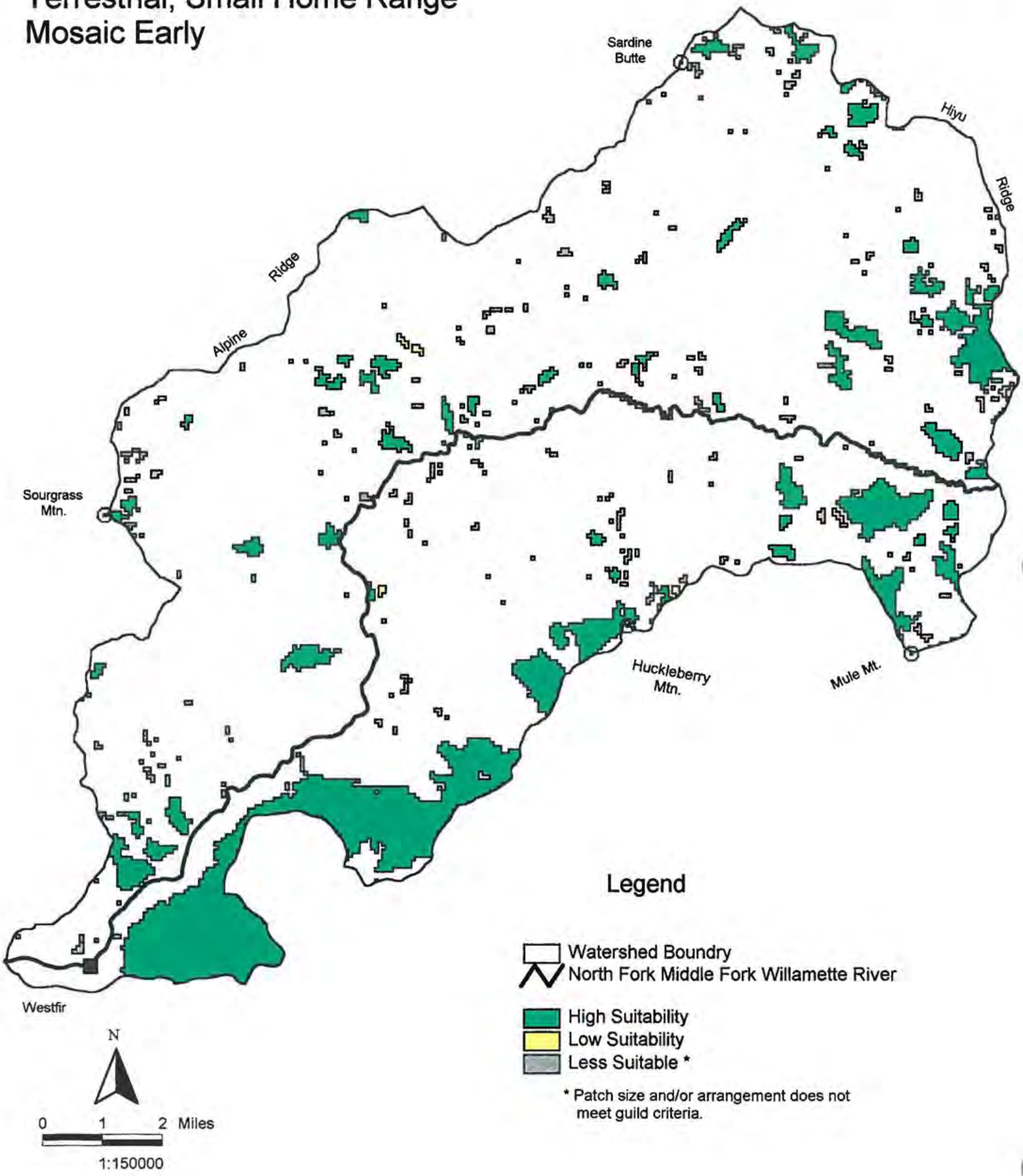


Figure: 6b
Historic
Terrestrial, Small Home Range
Mosaic Early

Upper North Fork Middle Fork
Willamette River Watershed

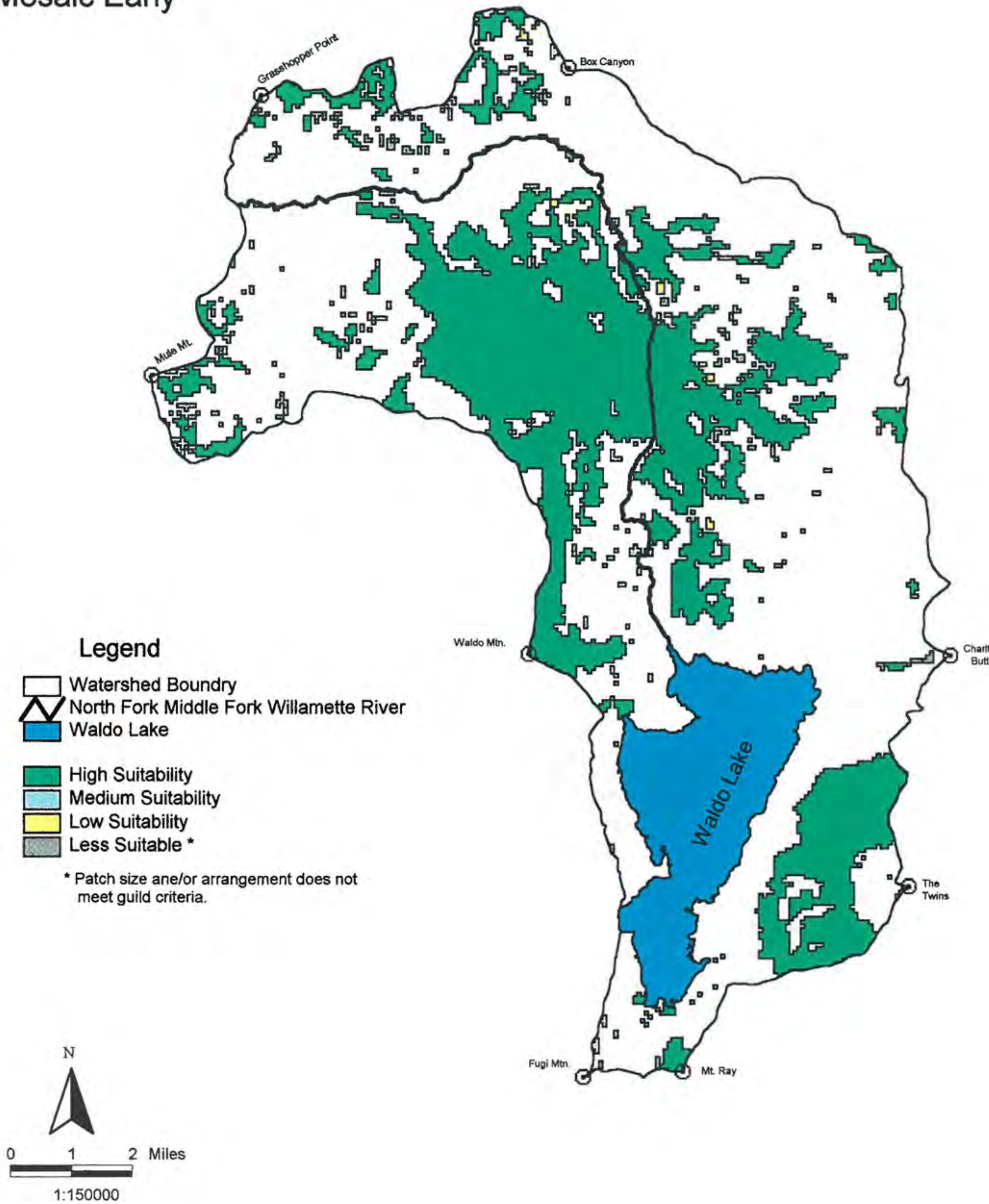


Figure: 7a

Historic

Terrestrial, Small Home Range

Generalist for Early and Mid Seral

Lower North Fork Middle Fork

Willamette River Watershed

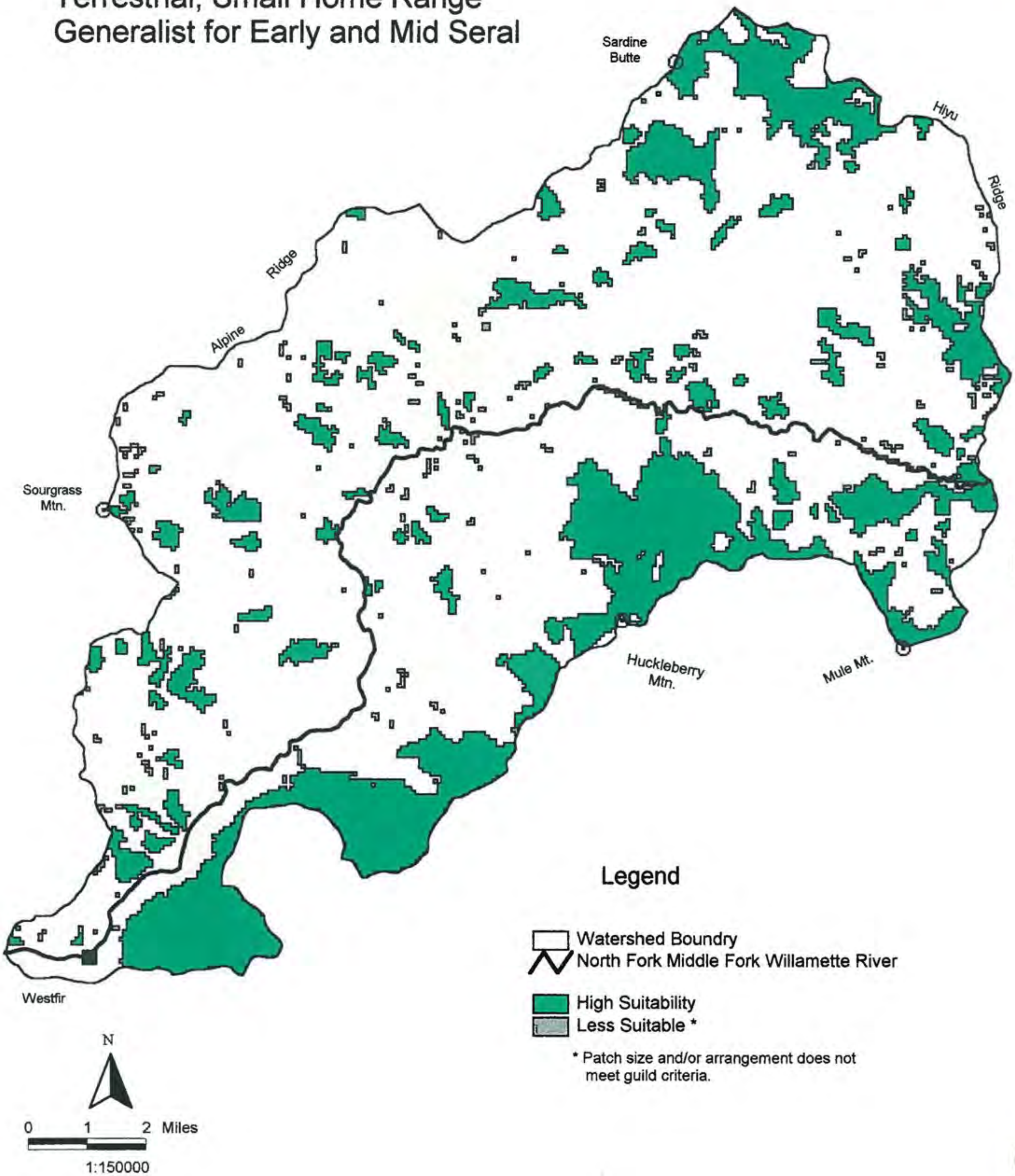


Figure: 7b
Historic
Terrestrial, Small Home Range
Generalist for Early and Mid Seral

Upper North Fork Middle Fork
Willamette River Watershed

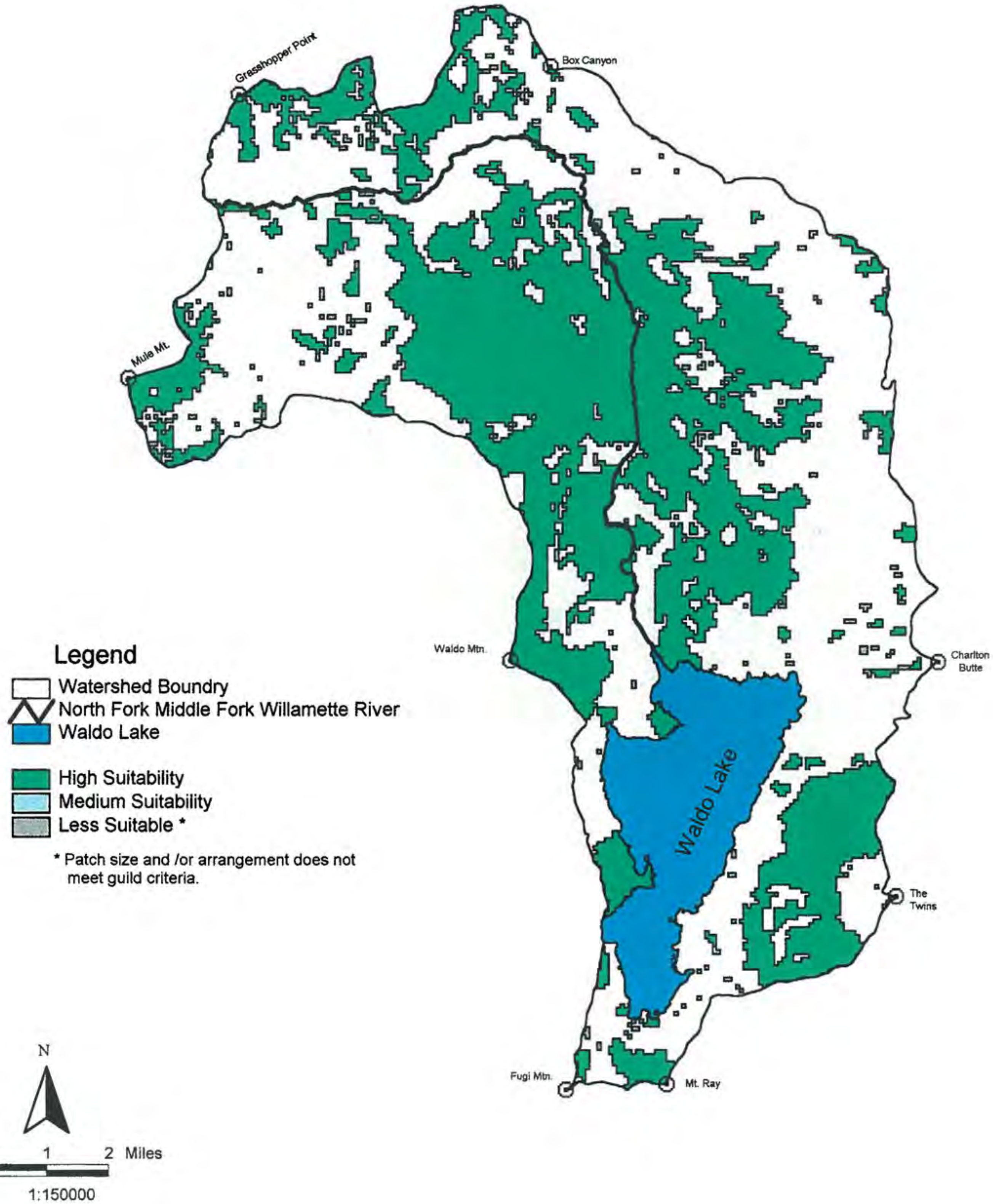


Figure: 8a

Historic

Terrestrial, Large Home Range, Mosaic, Late Seral

Lower North Fork Middle Fork Willamette River Watershed

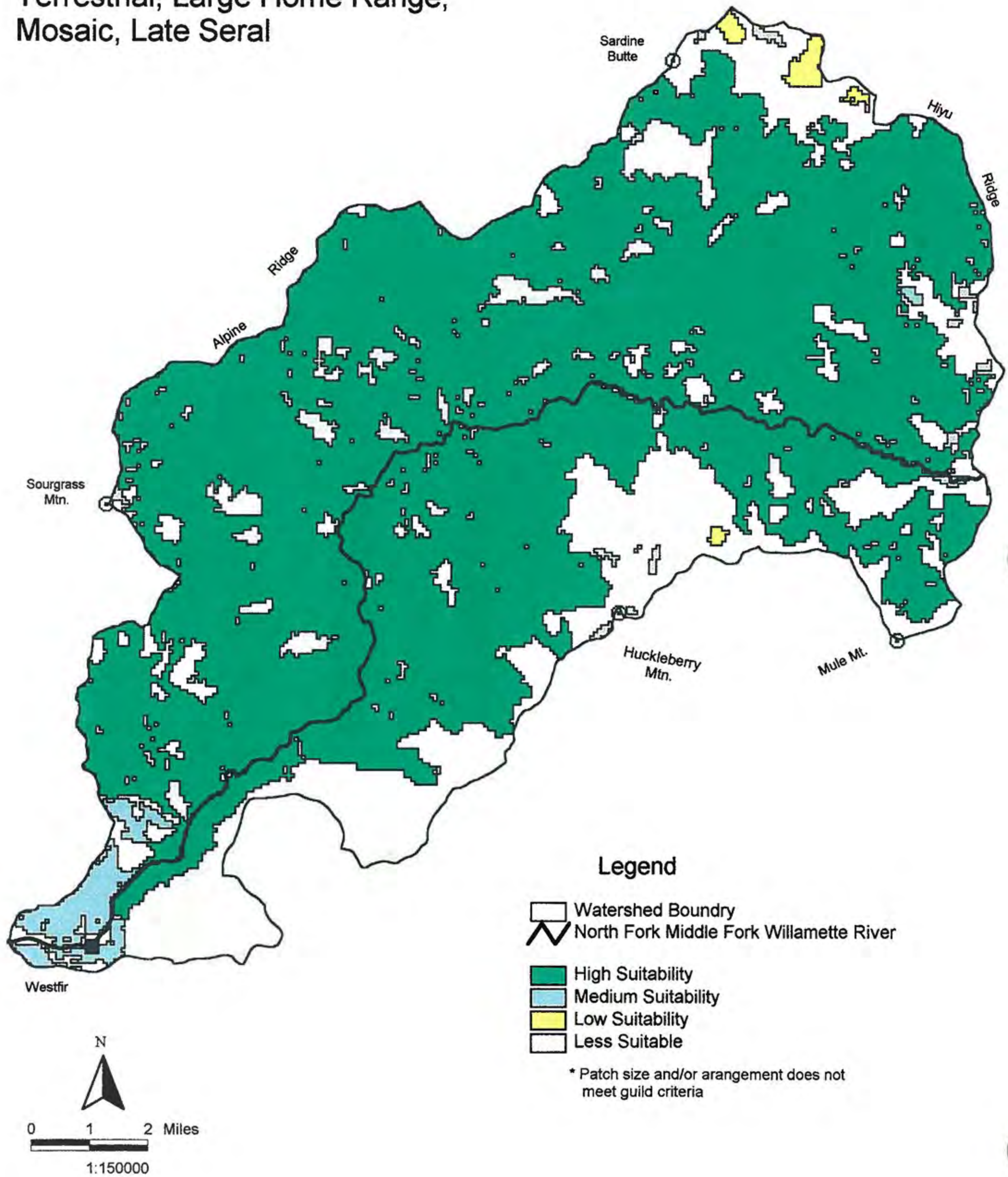


Figure: 8b

Historic

Terrestrial, Large Home Range, Mosaic, Late Seral

Upper North Fork Middle Fork Willamette River Watershed

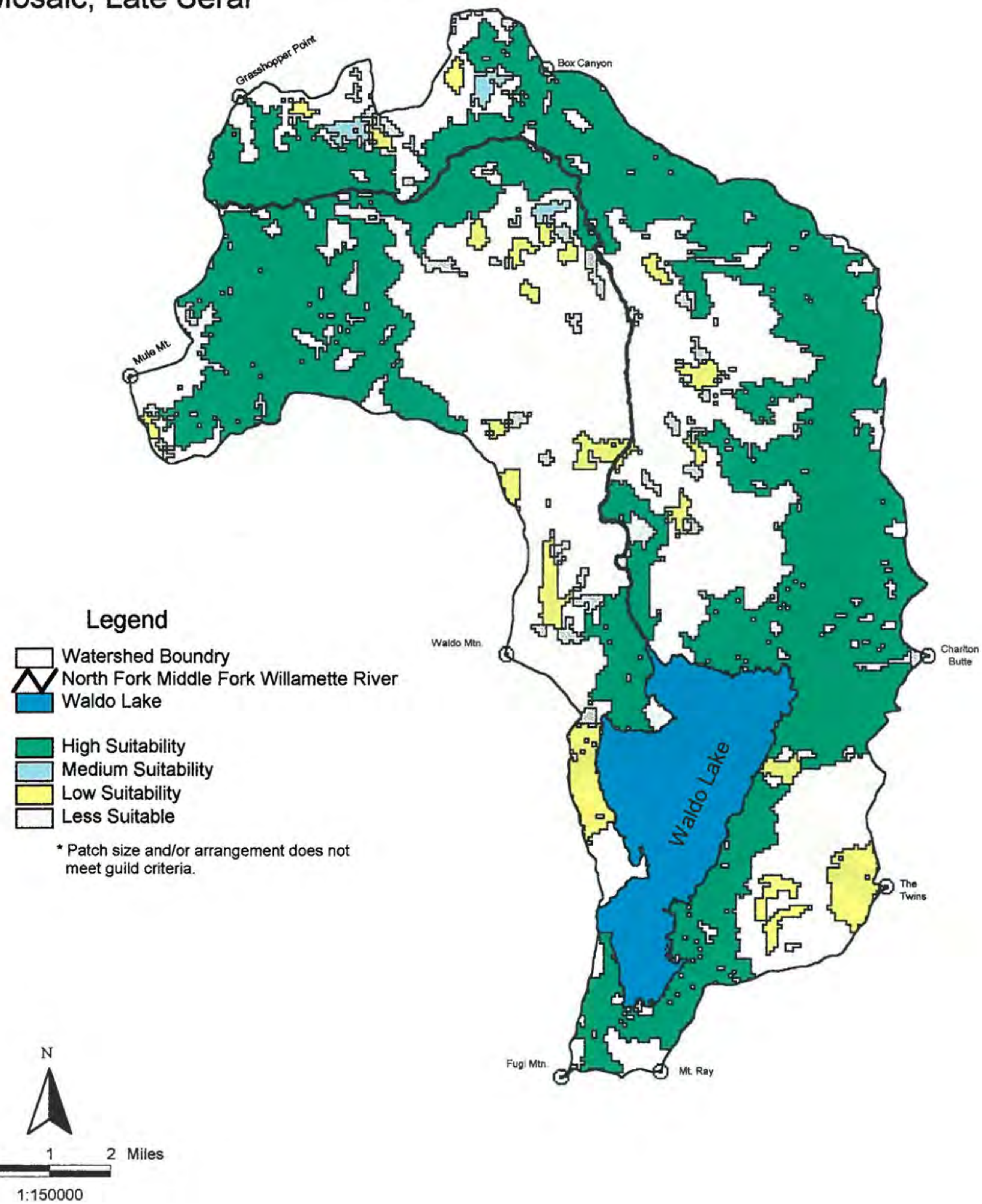


Figure: 9a
Historic
Terrestrial, Medium Home Range,
Mosaic, Late Seral

Lower North Fork Middle Fork Willamette River Watershed

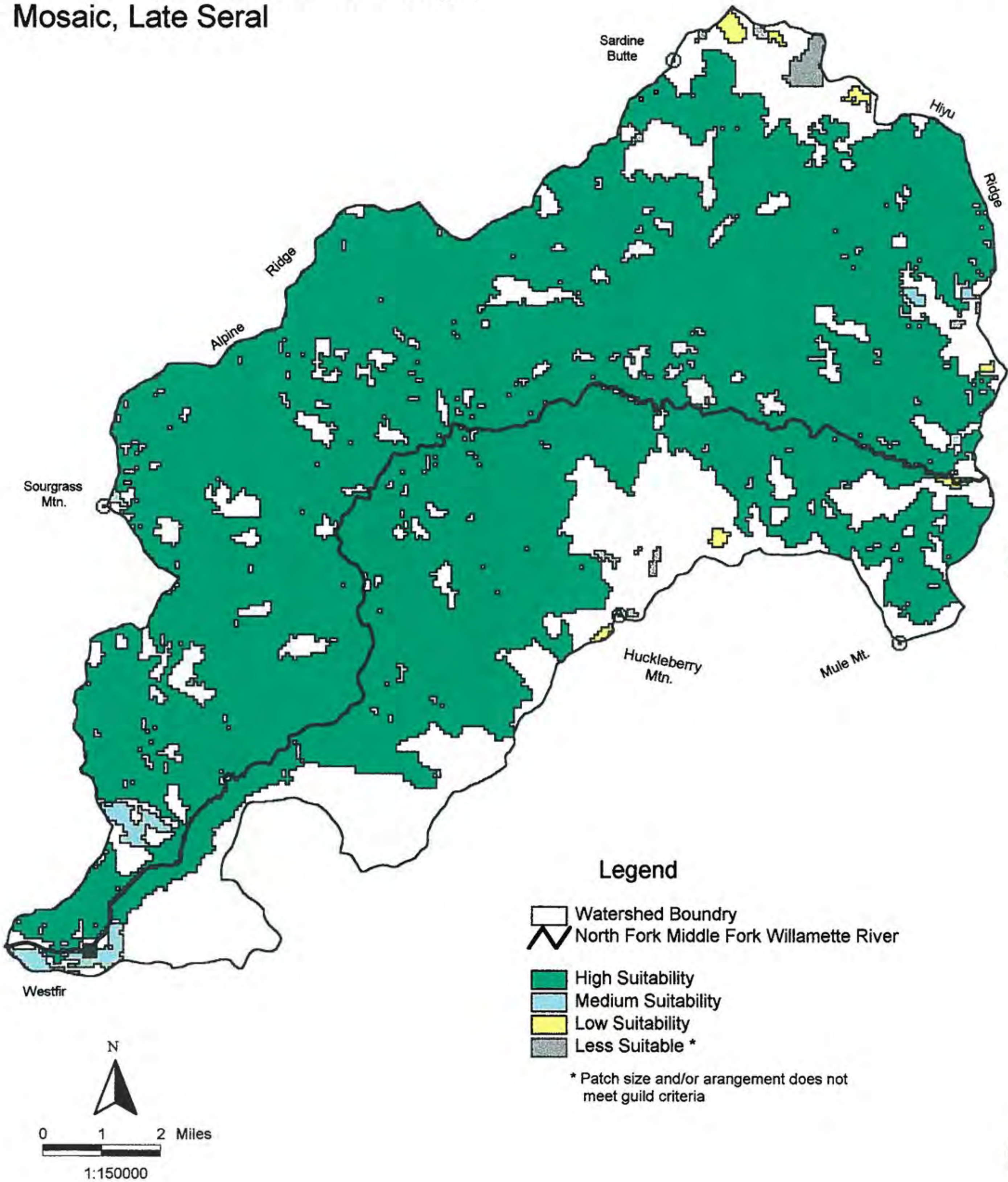


Figure: 9b
Historic
Terrestrial, Medium Home Range,
Mosaic, Late Seral

Upper North Fork Middle Fork
Willamette River Watershed

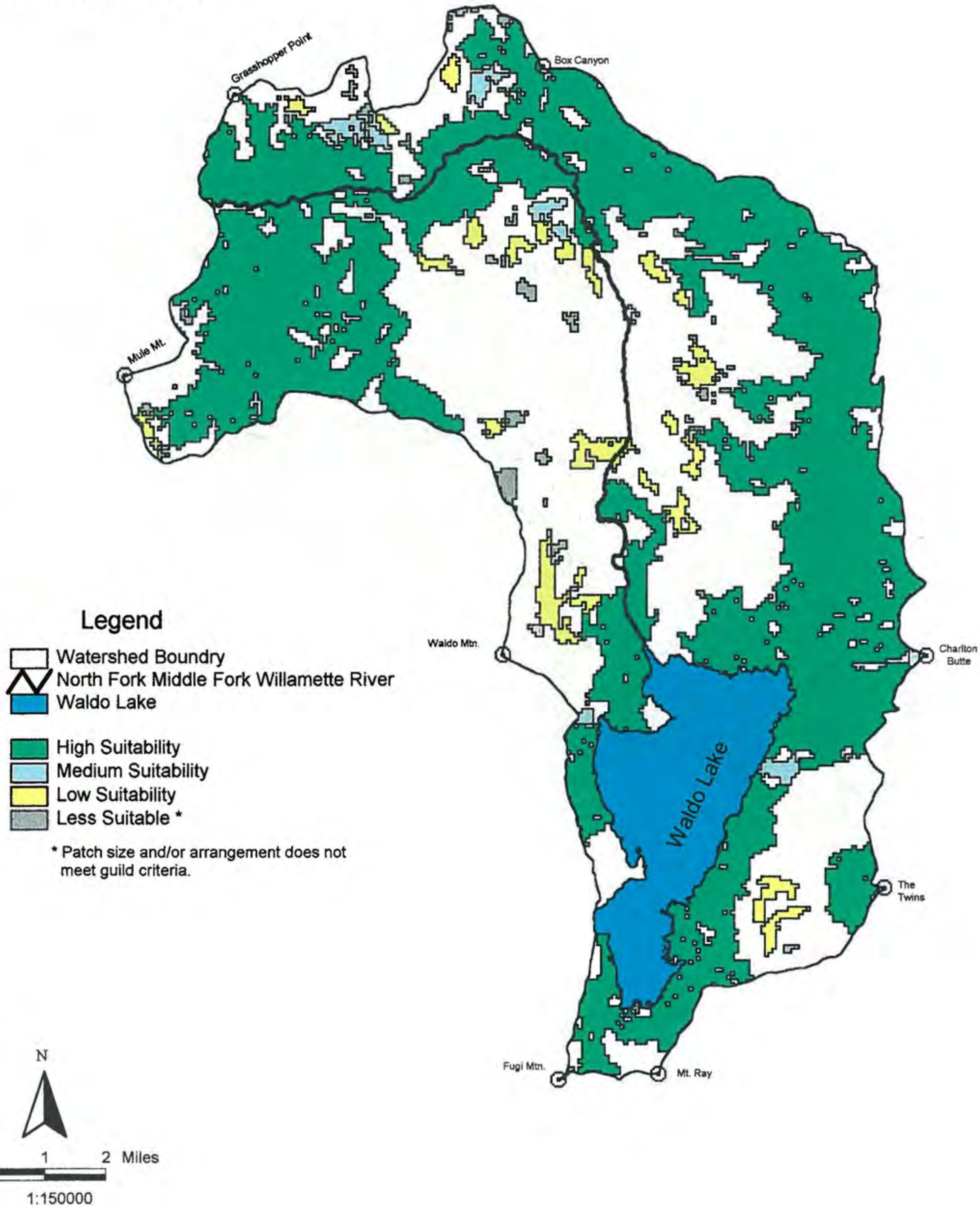


Figure: 10a

Historic
Terrestrial, Small Home Range
Generalist Mid/Late Seral

Lower North Fork Middle Fork
Willamette River Watershed

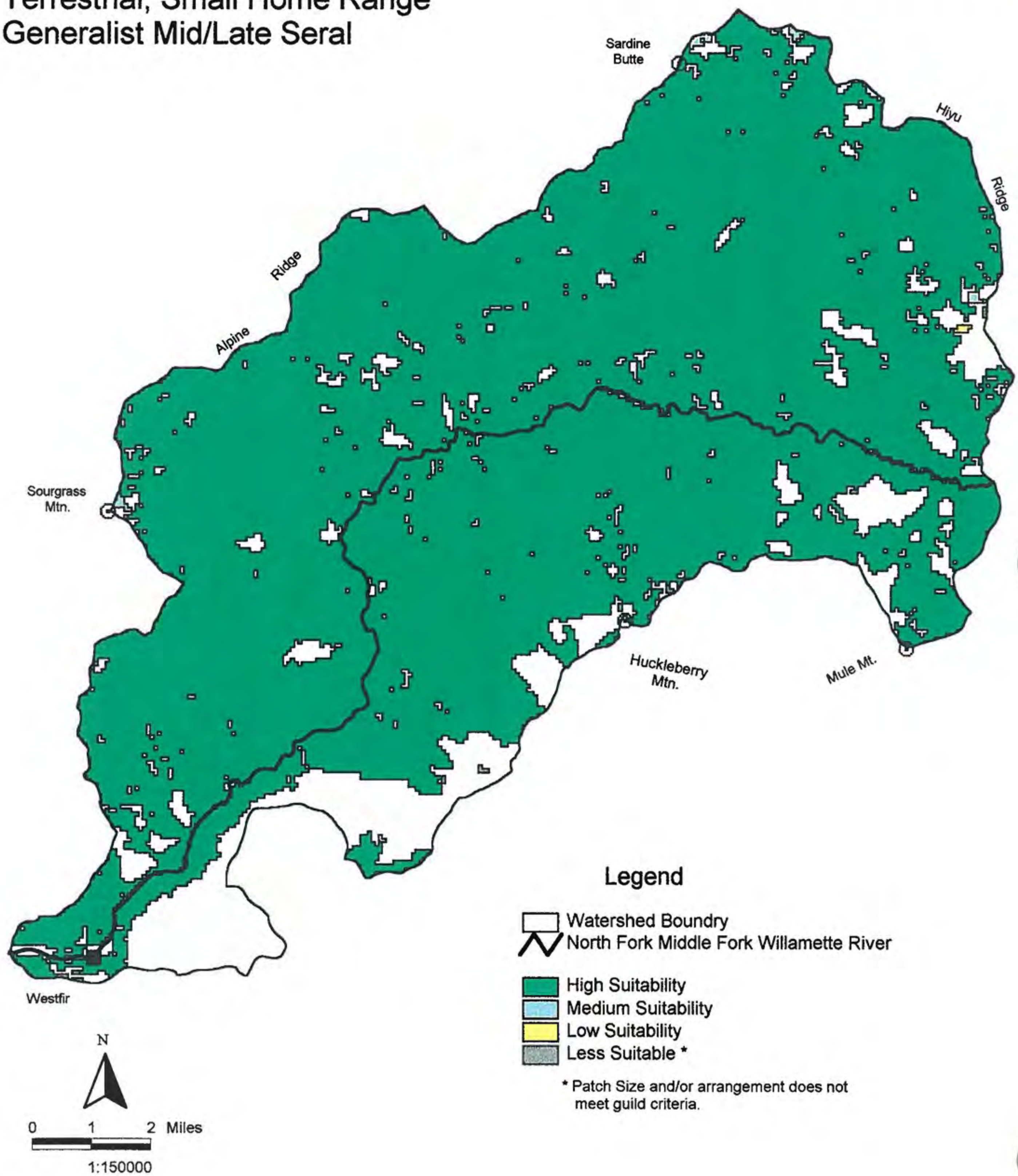


Figure: 10b

Historic

Terrestrial, Small Home Range

Generalist Mid/Late Seral

Upper North Fork Middle Fork Willamette River Watershed

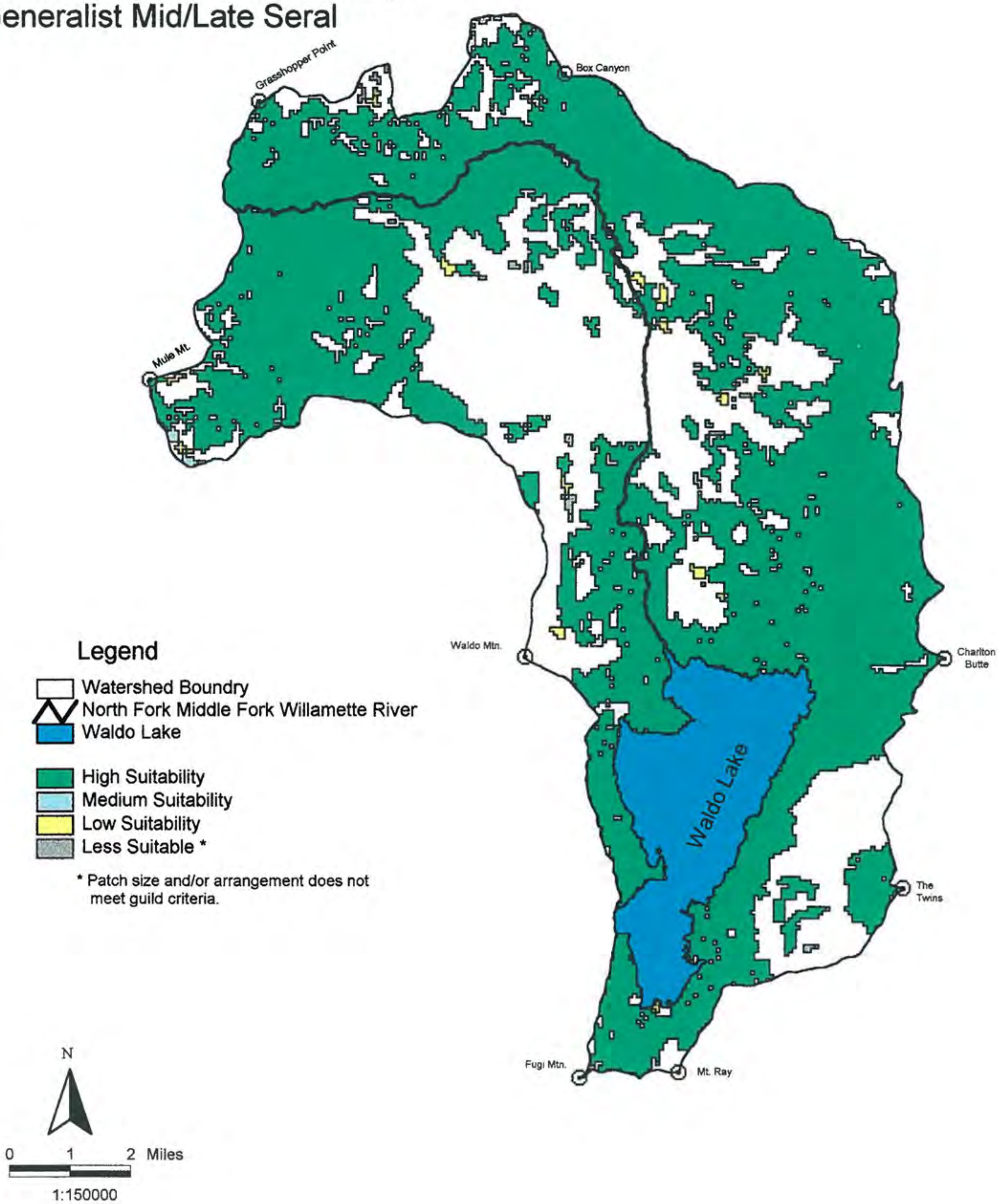


Figure: 11a
Current
Terrestrial Large Home Range
Contrast Species

Lower North Fork Middle Fork
Willamette River Watershed

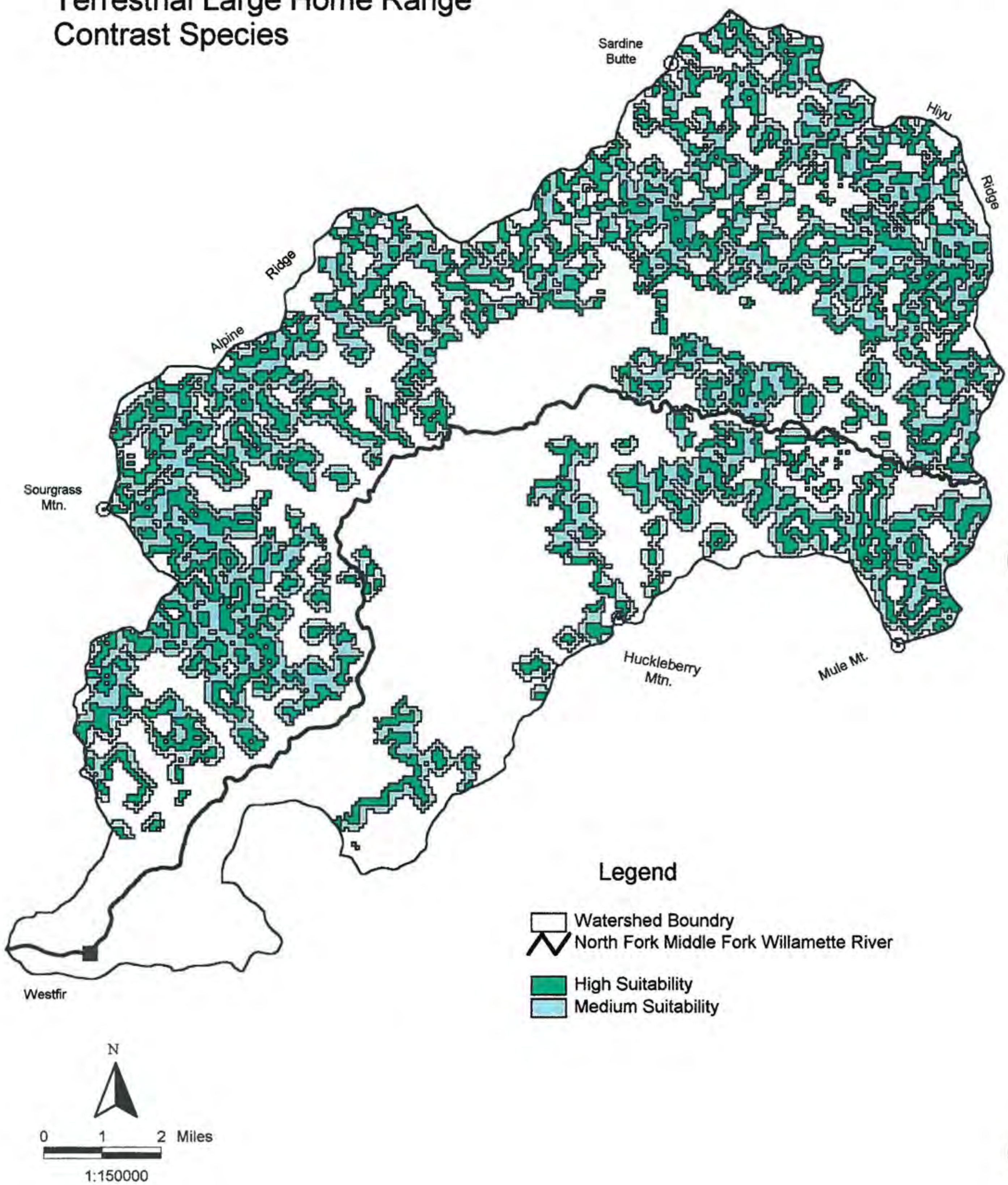


Figure: 11b
Current
Terrestrial Large Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

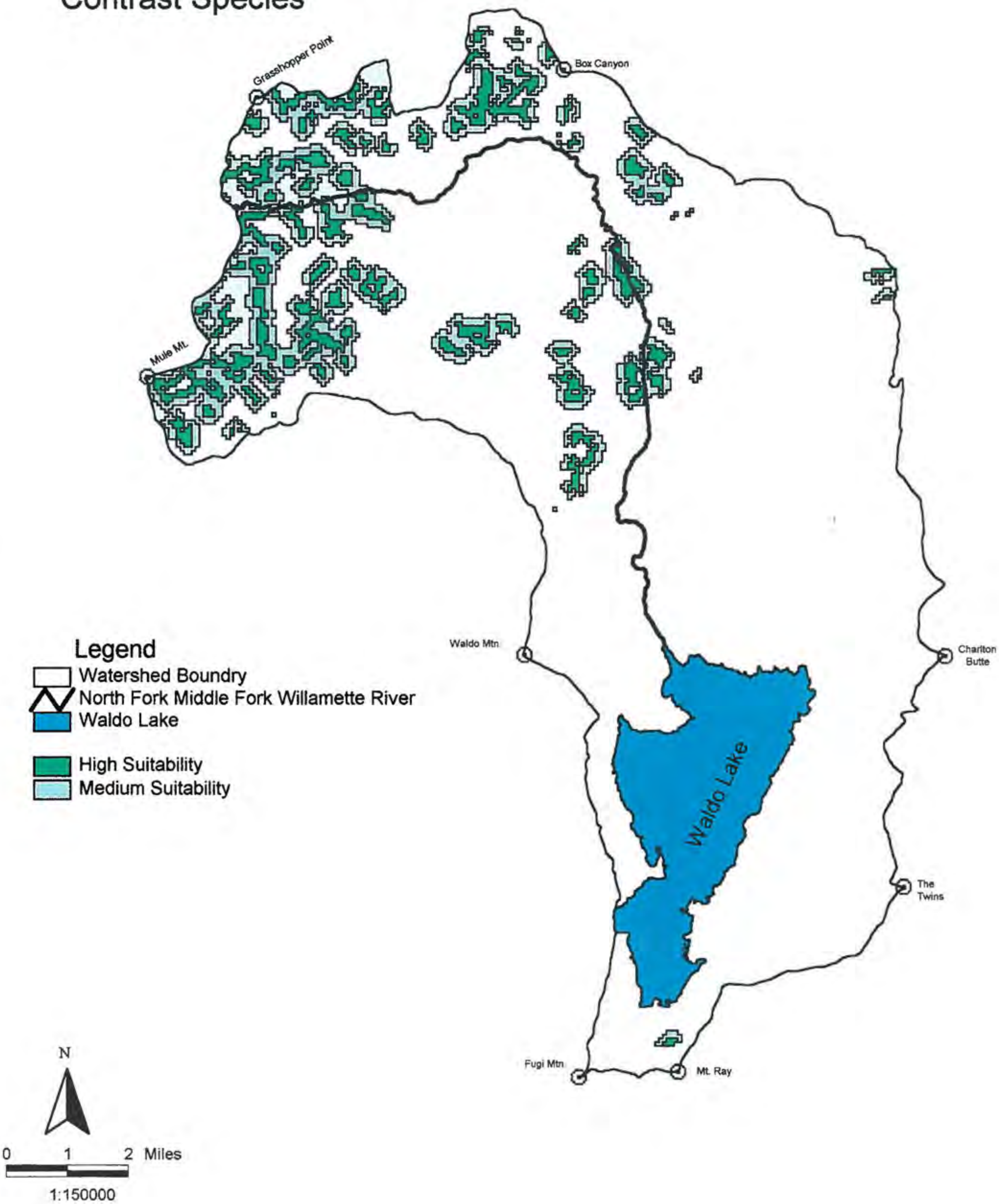


Figure: 12a

Current
Terrestrial, Medium Home Range
Contrast Species

Lower North Fork Middle Fork
Willamette River Watershed

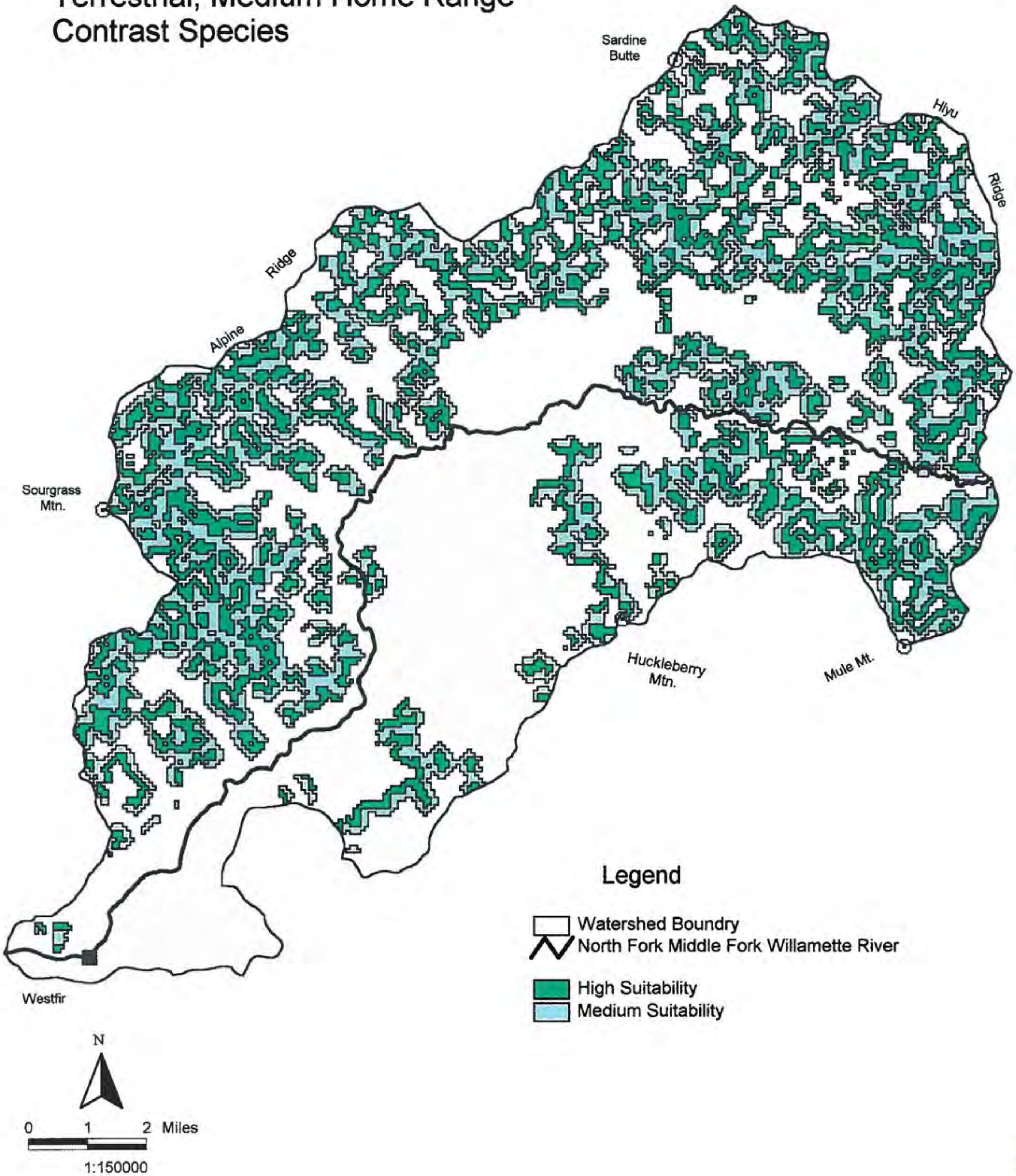


Figure: 12b
Current
Terrestrial, Medium Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

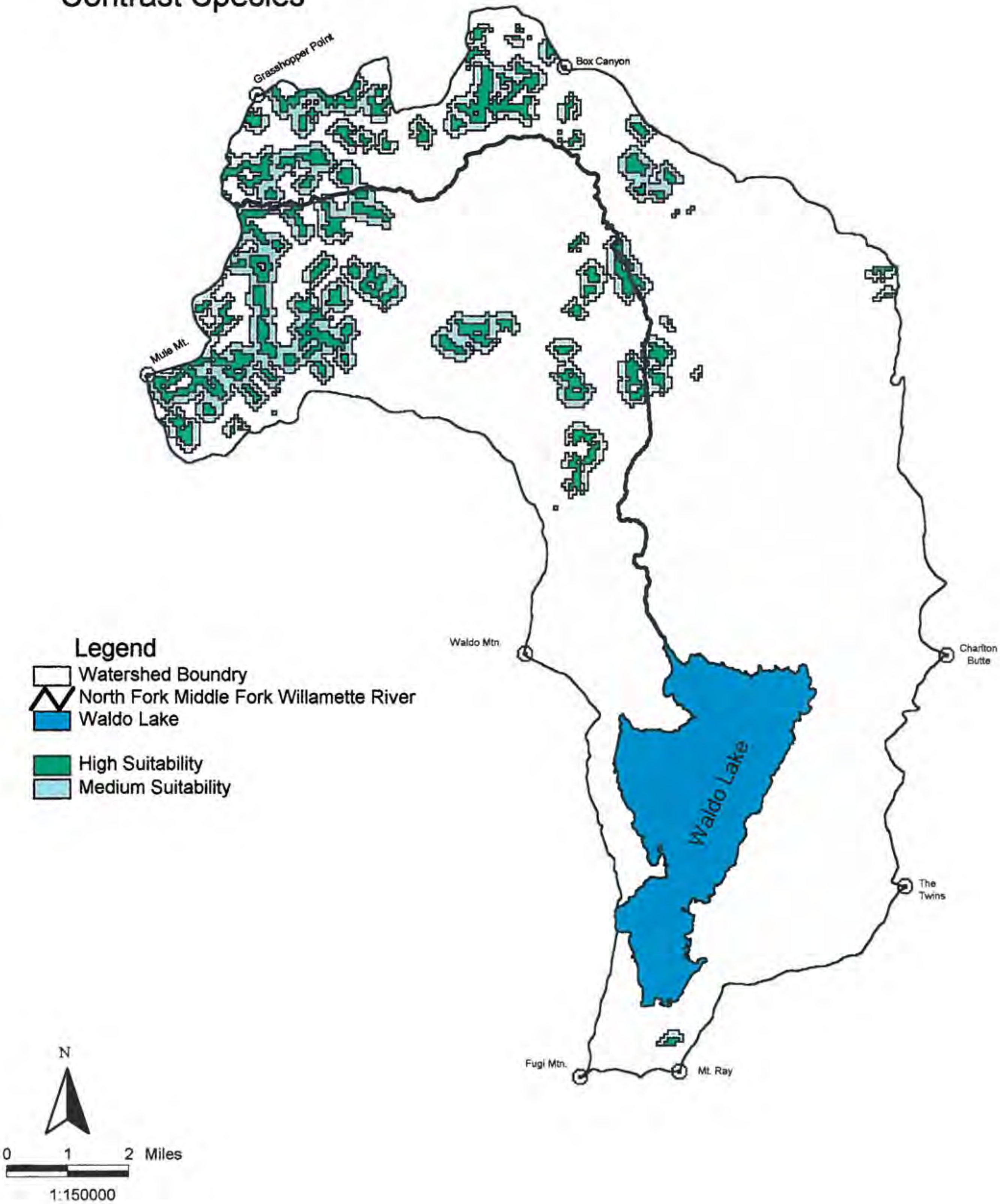


Figure: 13a
Current
Terrestrial, Small Home Range
Contrast Species

Lower North Fork Middle Fork
Willamette River Watershed

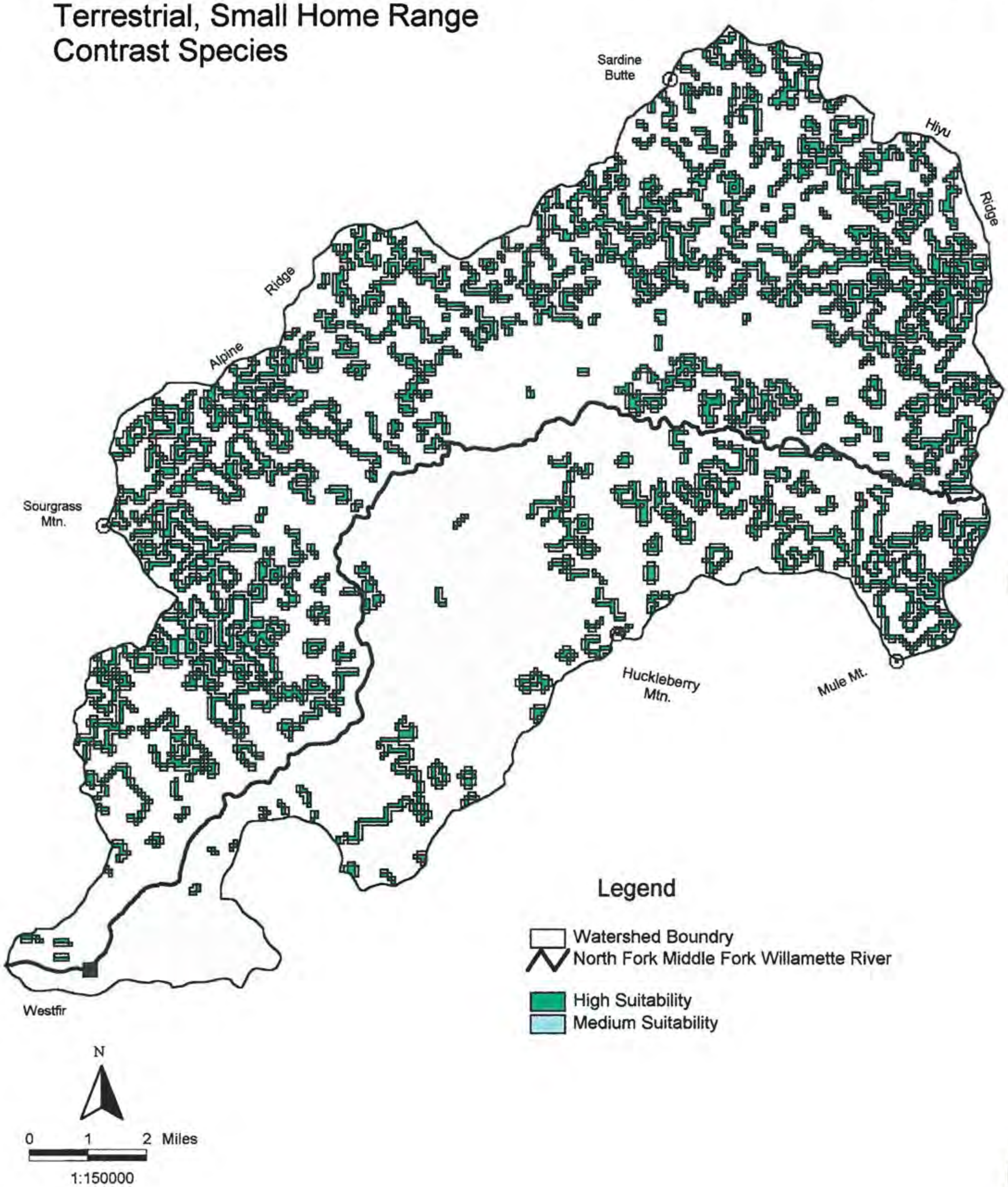


Figure: 13b
Current
Terrestrial, Small Home Range
Contrast Species

Upper North Fork Middle Fork
Willamette River Watershed

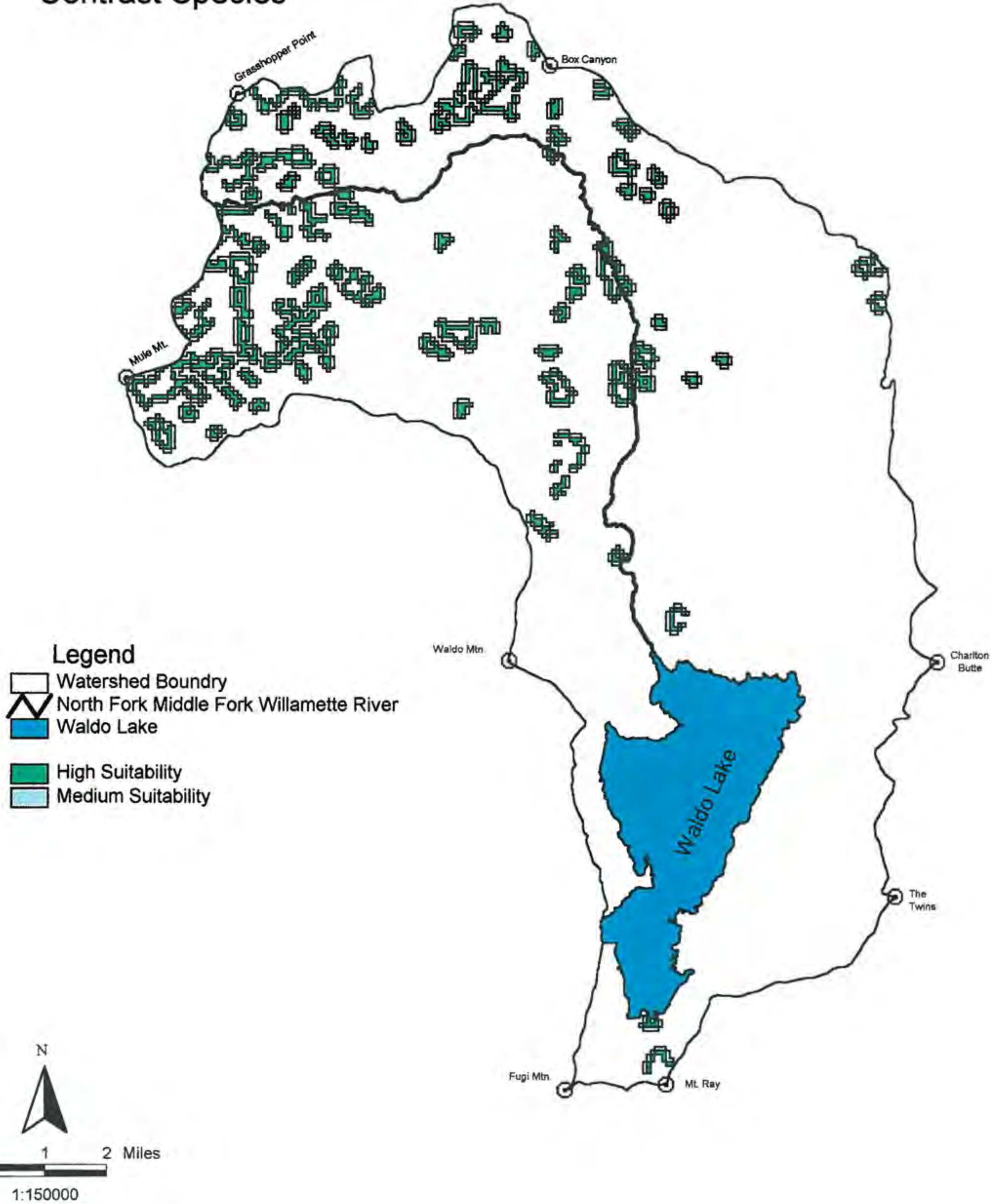


Figure: 14a
Current
Terrestrial, Large Home Range,
Mosaic, Early Seral

Lower North Fork Middle Fork
Willamette River Watershed

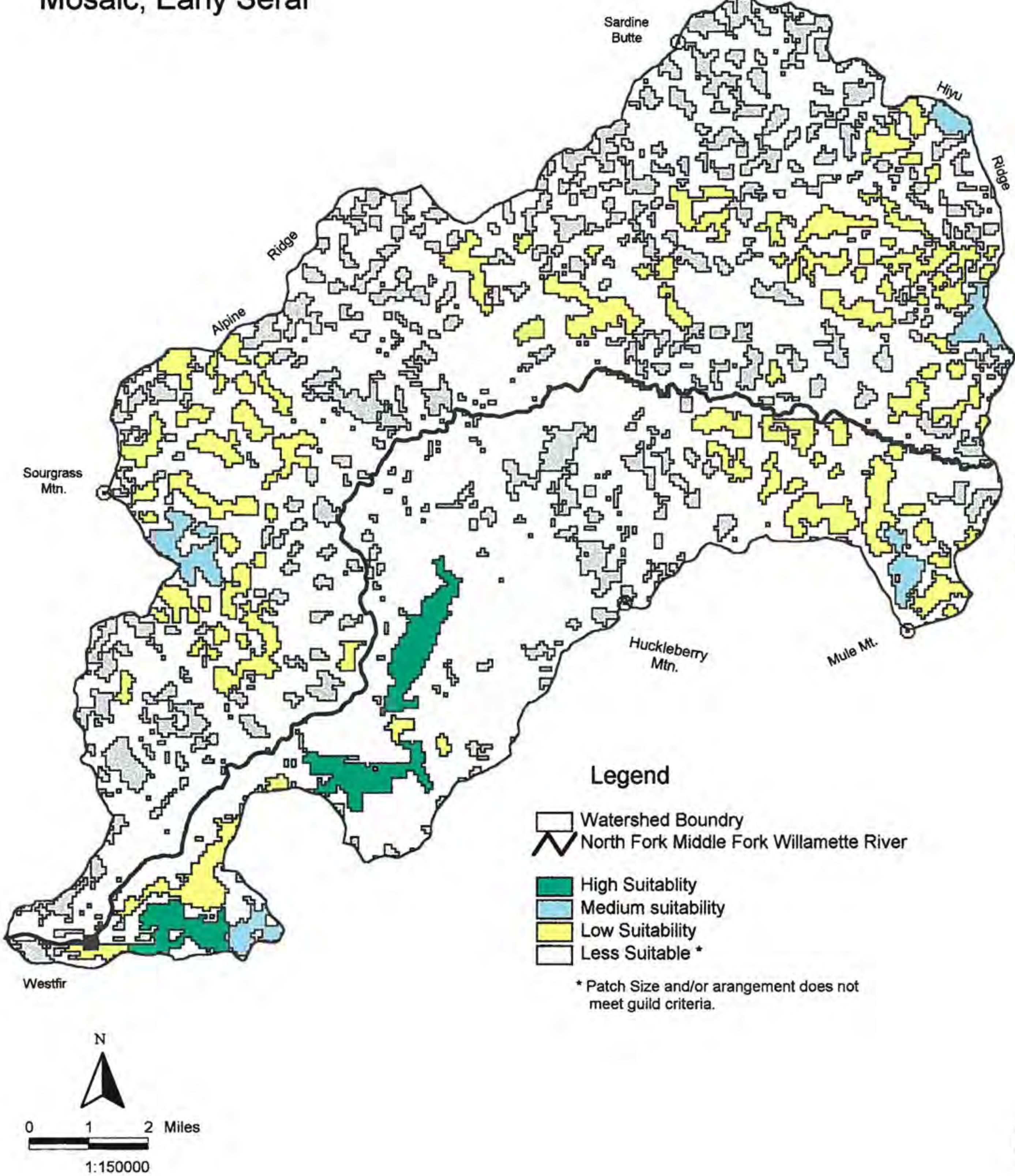


Figure: 14b
Current
Terrestrial, Large Home Range
Mosaic, Early Seral

Upper North Fork Middle Fork
Willamette River Watershed

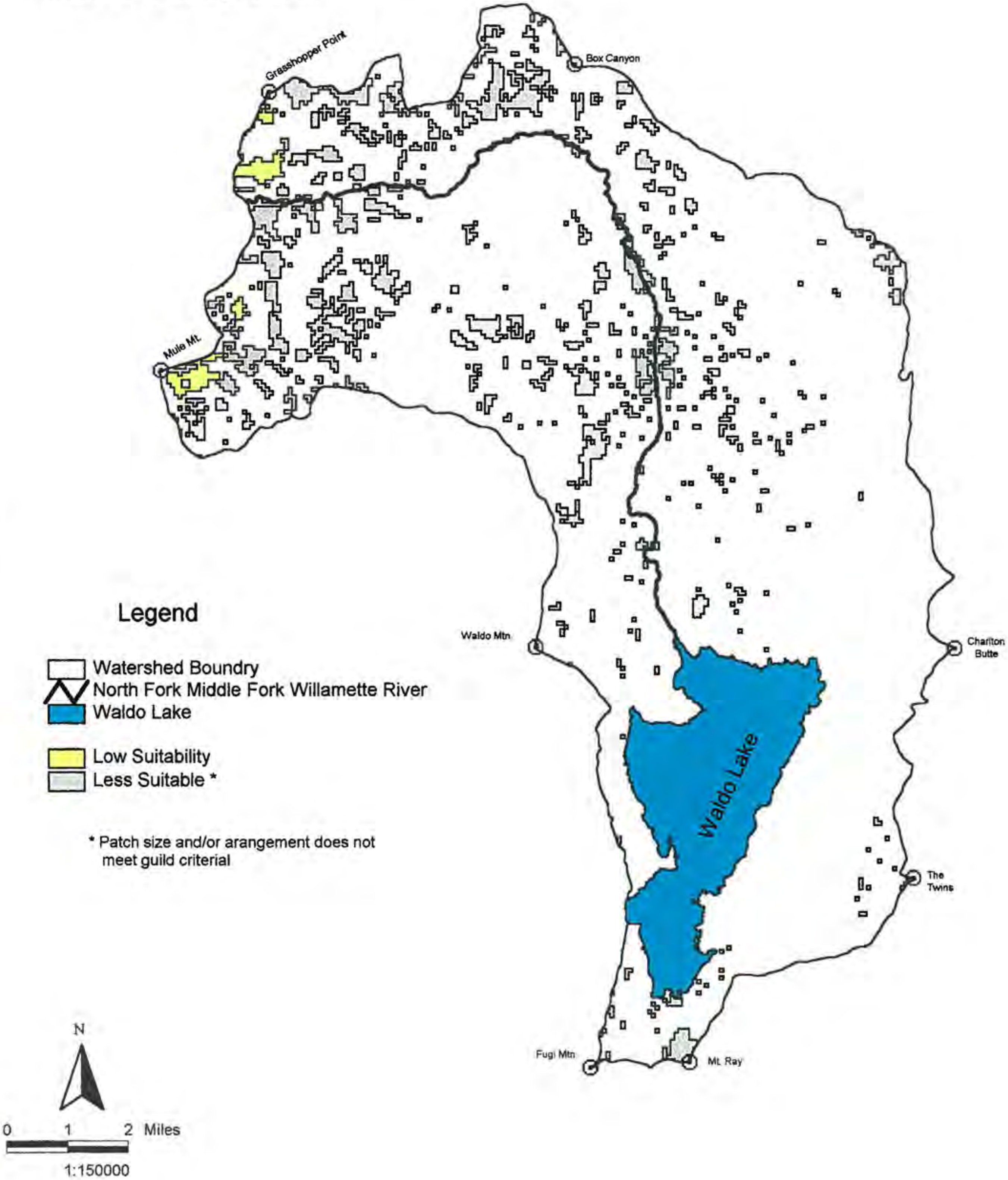


Figure: 15a
Current
Terrestrial, Medium Home Range,
Mosaic, Early Seral

Lower North Fork Middle Fork
Willamette River Watershed

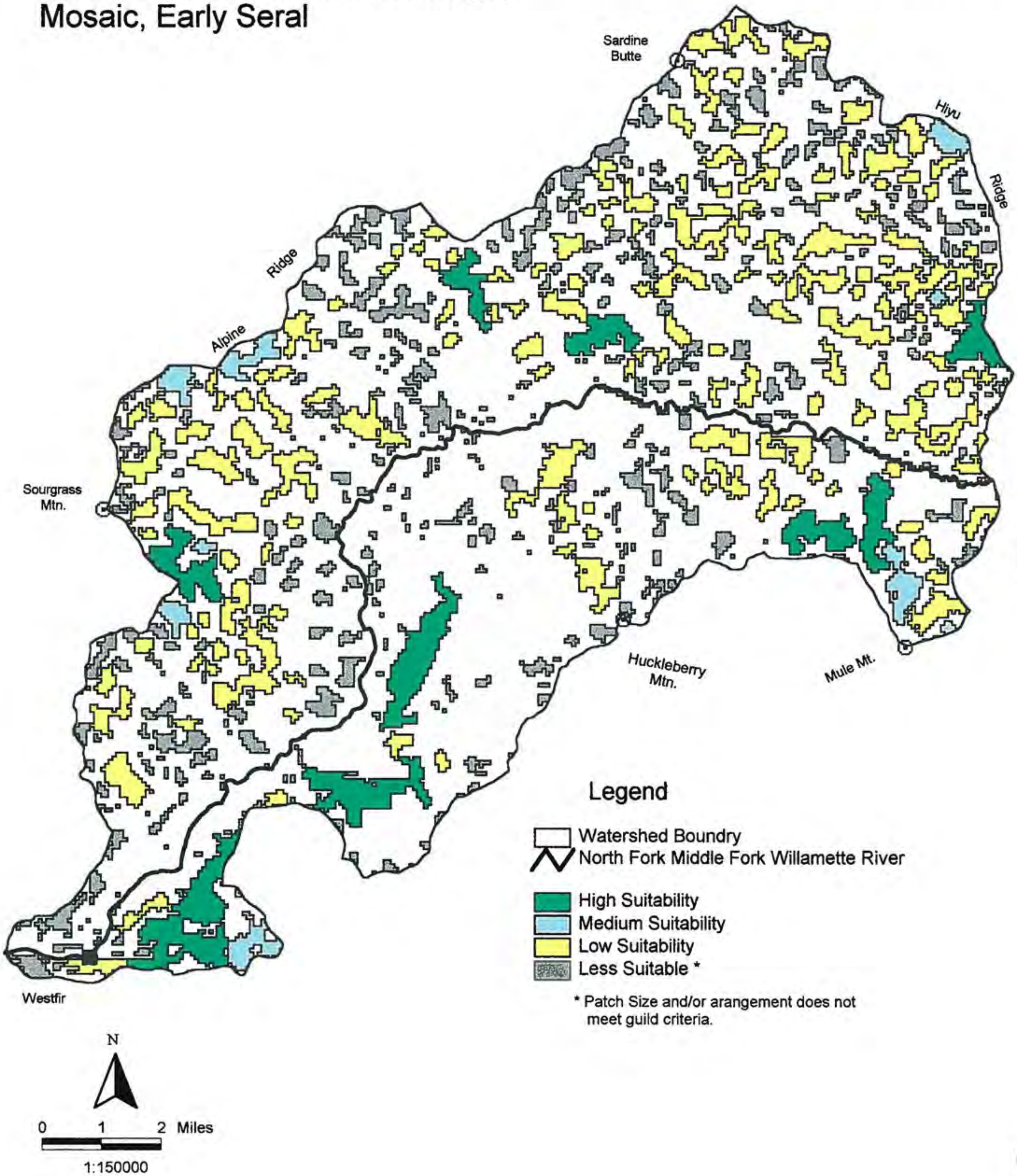
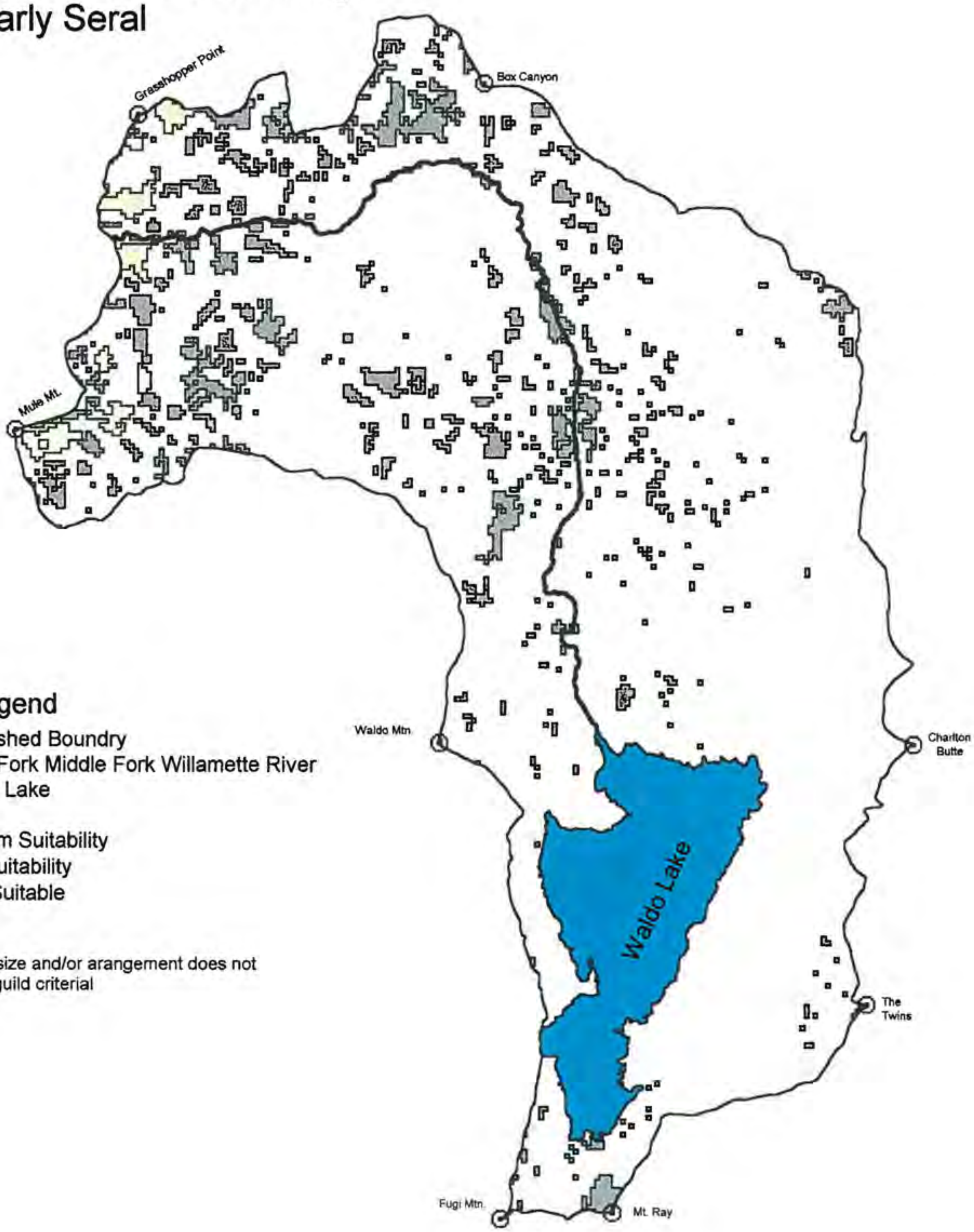


Figure: 15b
Current
Terrestrial, Medium Home Range
Mosaic, Early Seral

Upper North Fork Middle Fork
Willamette River Watershed



Legend
Watershed Boundry
North Fork Middle Fork Willamette River
Waldo Lake

Medium Suitability
Low Suitability
Less Suitable

* Patch size and/or arangement does not meet guild criterial

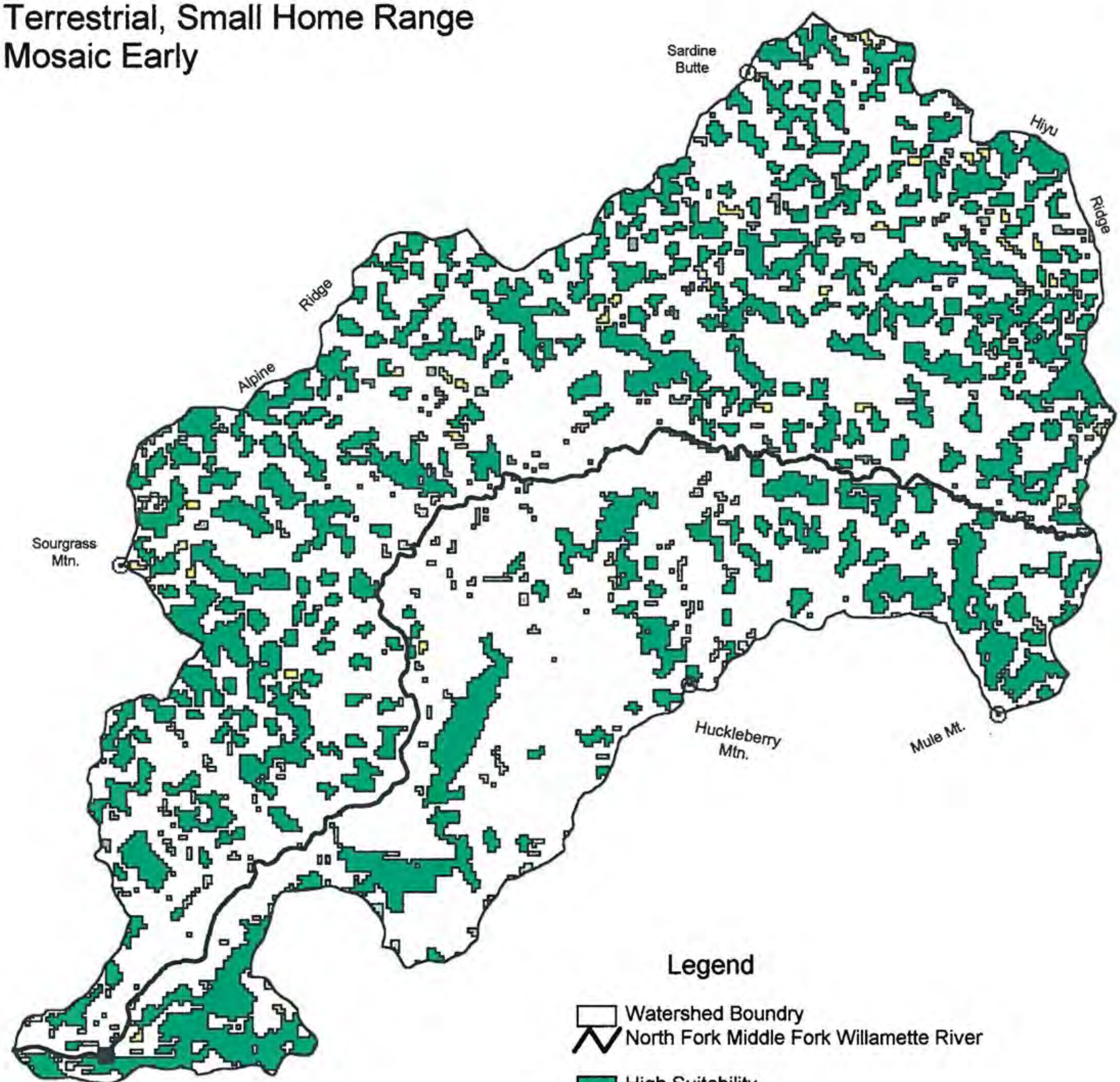
N

0 1 2 Miles
1:150000

Figure: 16a

Current
Terrestrial, Small Home Range
Mosaic Early

Lower North Fork Middle Fork Willamette River Watershed



Legend

- Watershed Boundry
- North Fork Middle Fork Willamette River
- High Suitability
- Medium Suitability
- Low Suitability
- Less Suitable *

* Patch size and/or arrangement does not meet guild criteria.

N

0 1 2 Miles

1:150000

Figure: 16b

Current

Terrestrial, Small Home Range

Mosaic Early

Upper North Fork Middle Fork Willamette River Watershed

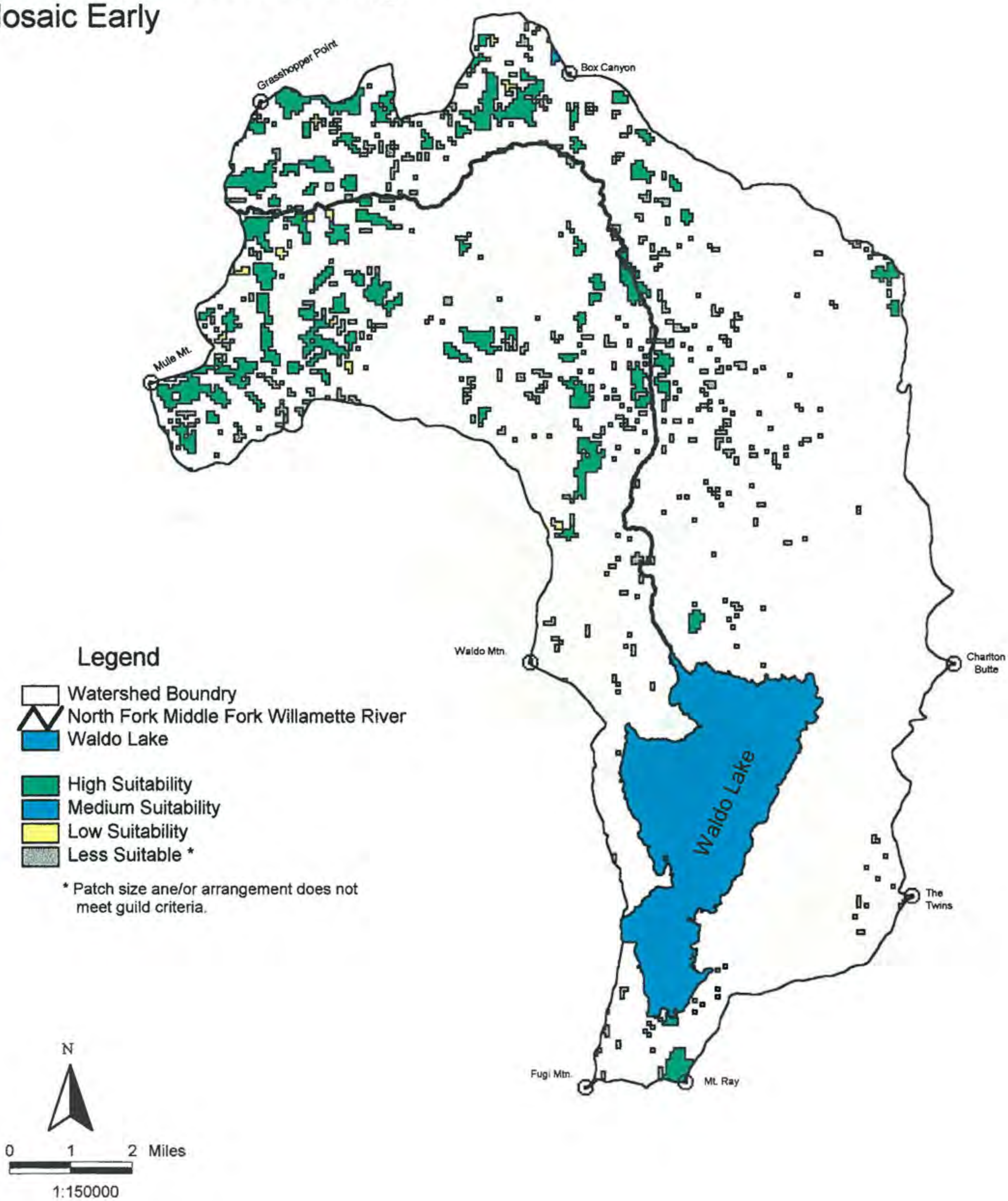


Figure: 17a

Current
Terrestrial, Small Home Range
Generalist for Early and Mid Seral

Lower North Fork Middle Fork
Willamette River Watershed

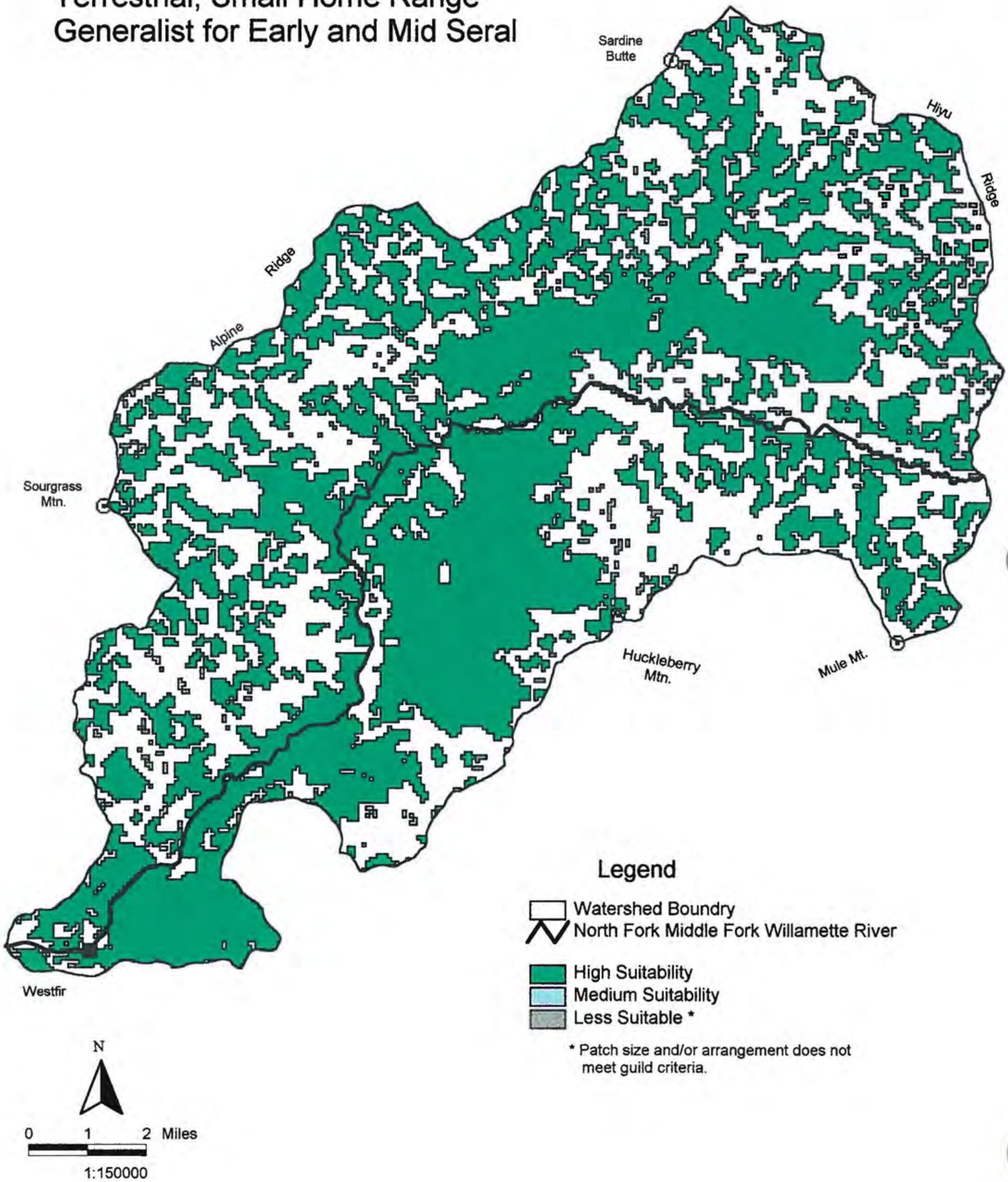


Figure: 17b
Current
Terrestrial, Small Home Range
Generalist for Early and Mid Seral

Upper North Fork Middle Fork
Willamette River Watershed

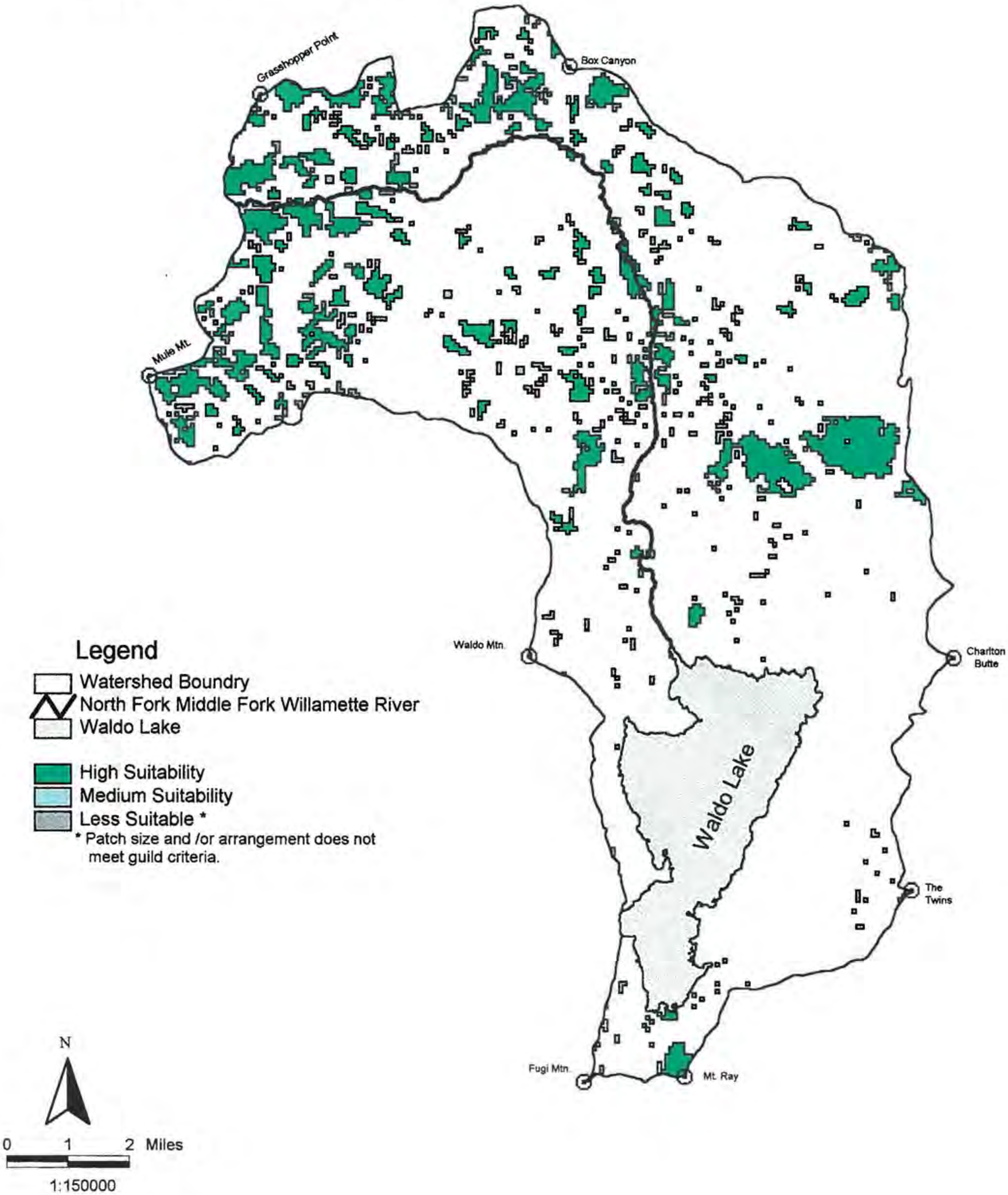


Figure: 18a
Current
Terrestrial, Large Home Range,
Mosaic, Late Seral

Lower North Fork Middle Fork
Willamette River Watershed

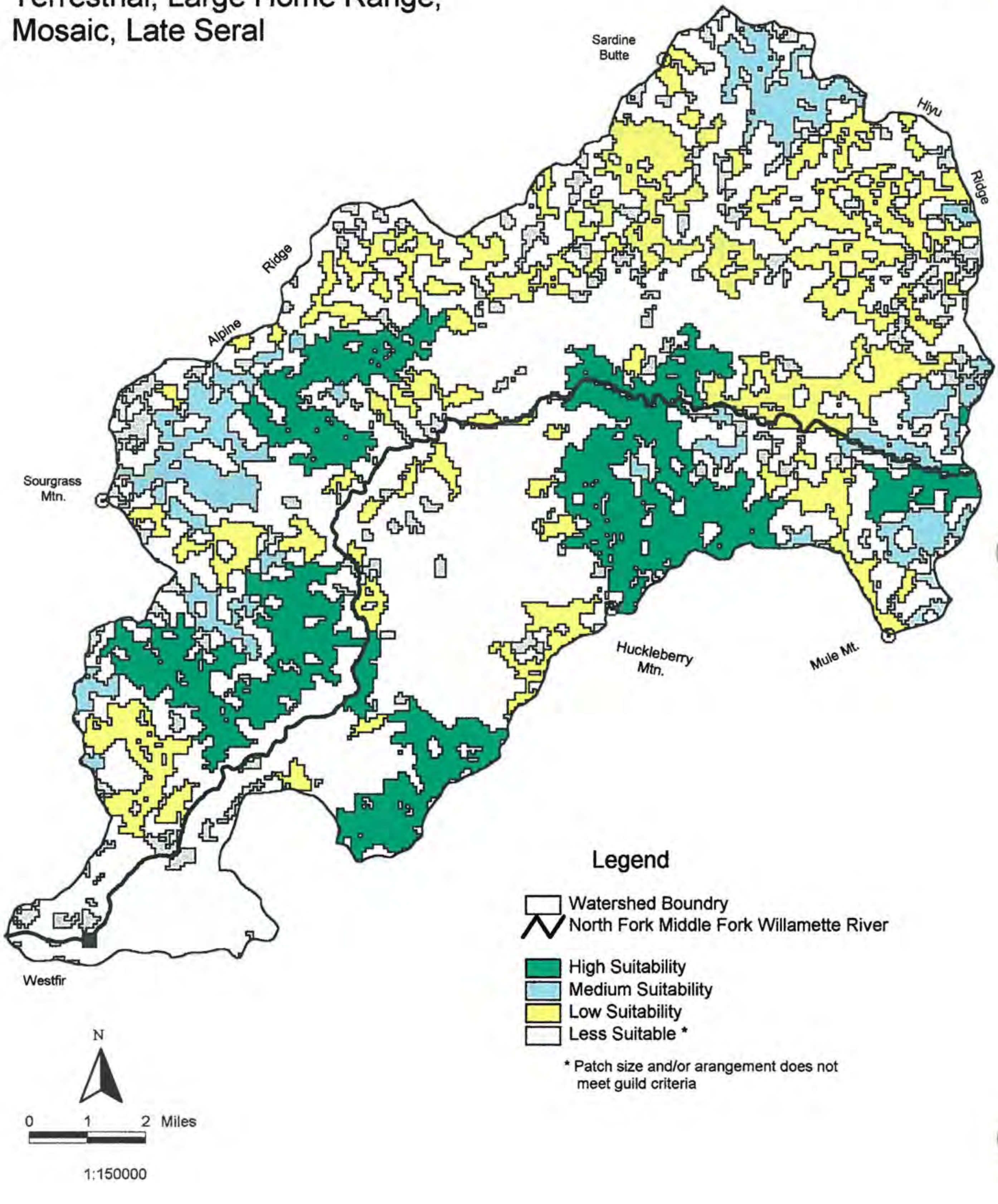


Figure: 18b

Current
Terrestrial, Large Home Range, Mosaic, Late Seral

Upper North Fork Middle Fork Willamette River Watershed

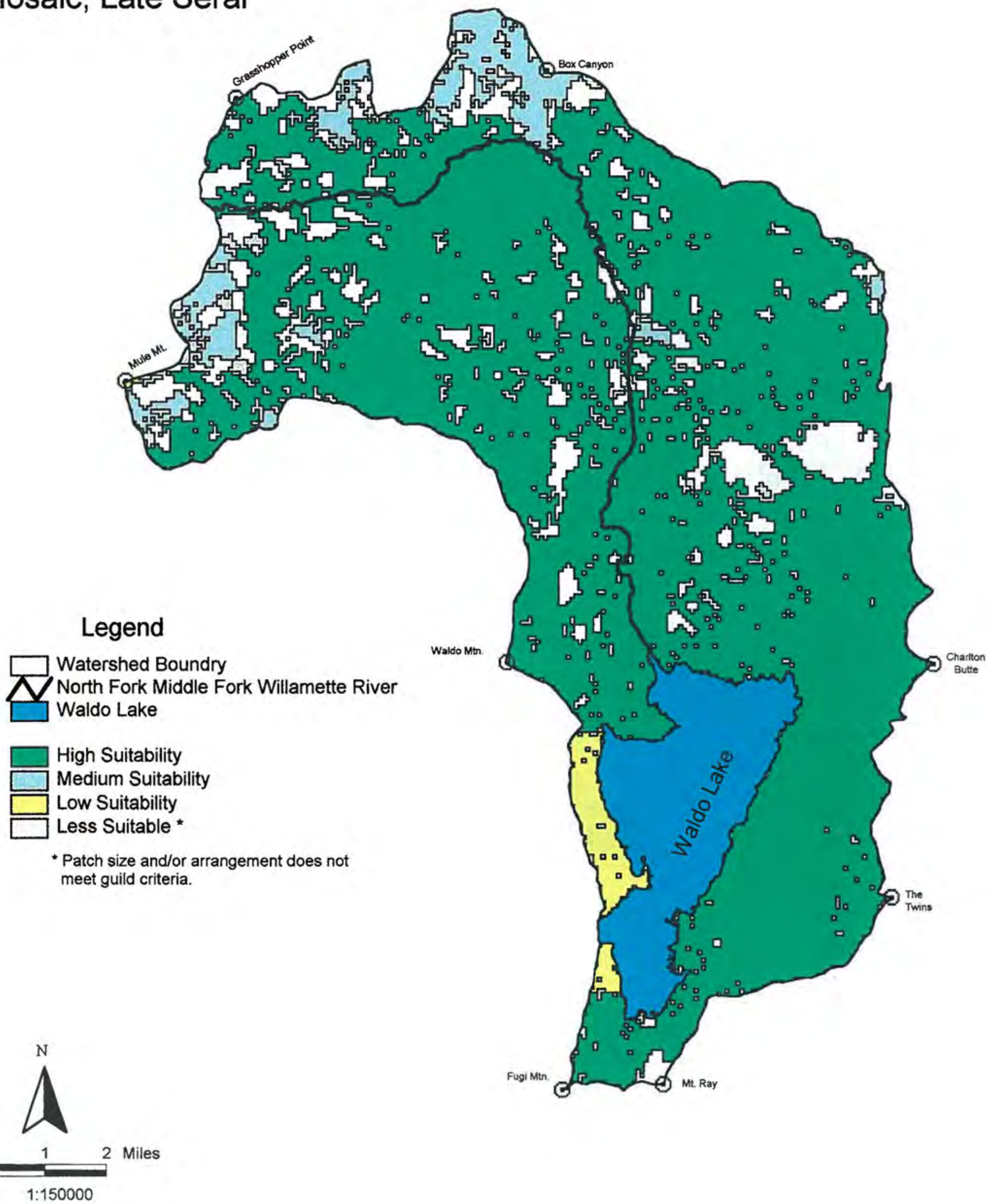


Figure: 19a

Current

Terrestrial, Medium Home Range, Mosaic, Late Seral

Lower North Fork Middle Fork Willamette River Watershed

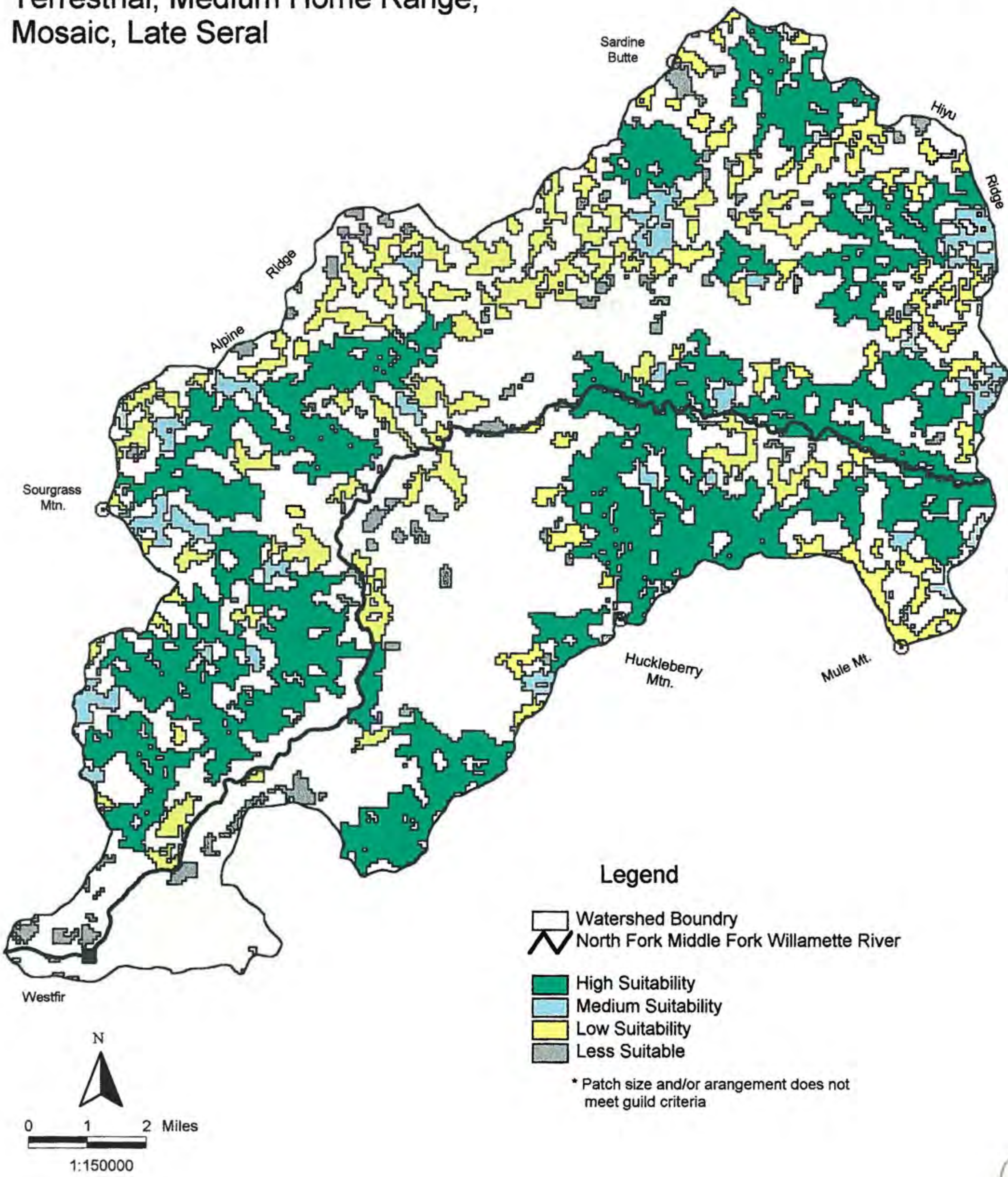


Figure: 19b
Current
Terrestrial, Medium Home Range,
Mosaic, Late Seral

Upper North Fork Middle Fork
Willamette River Watershed

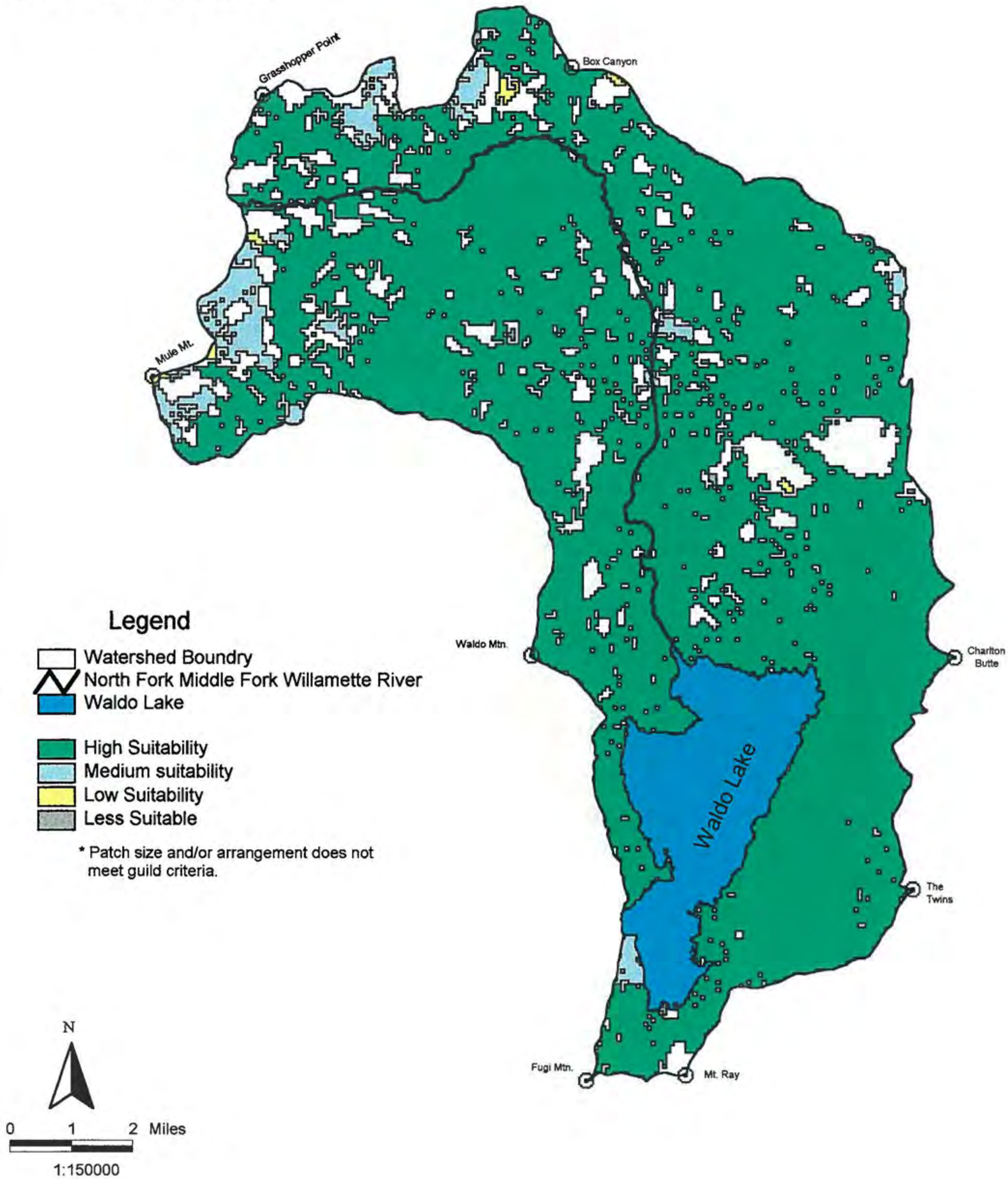


Figure: 20a

Current

Terrestrial, Small Home Range

Generalist Mid/Late Seral

Lower North Fork Middle Fork Willamette River Watershed

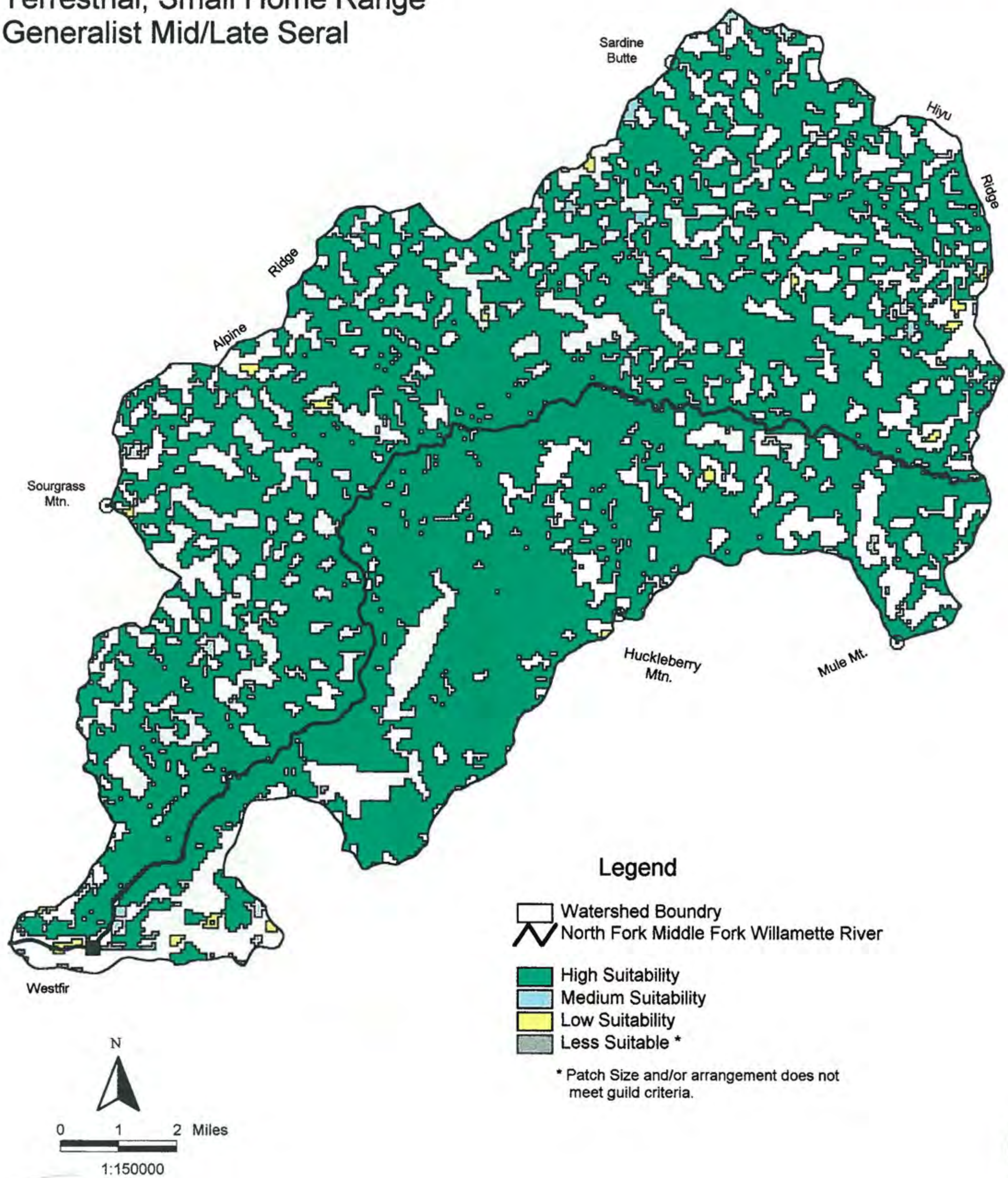
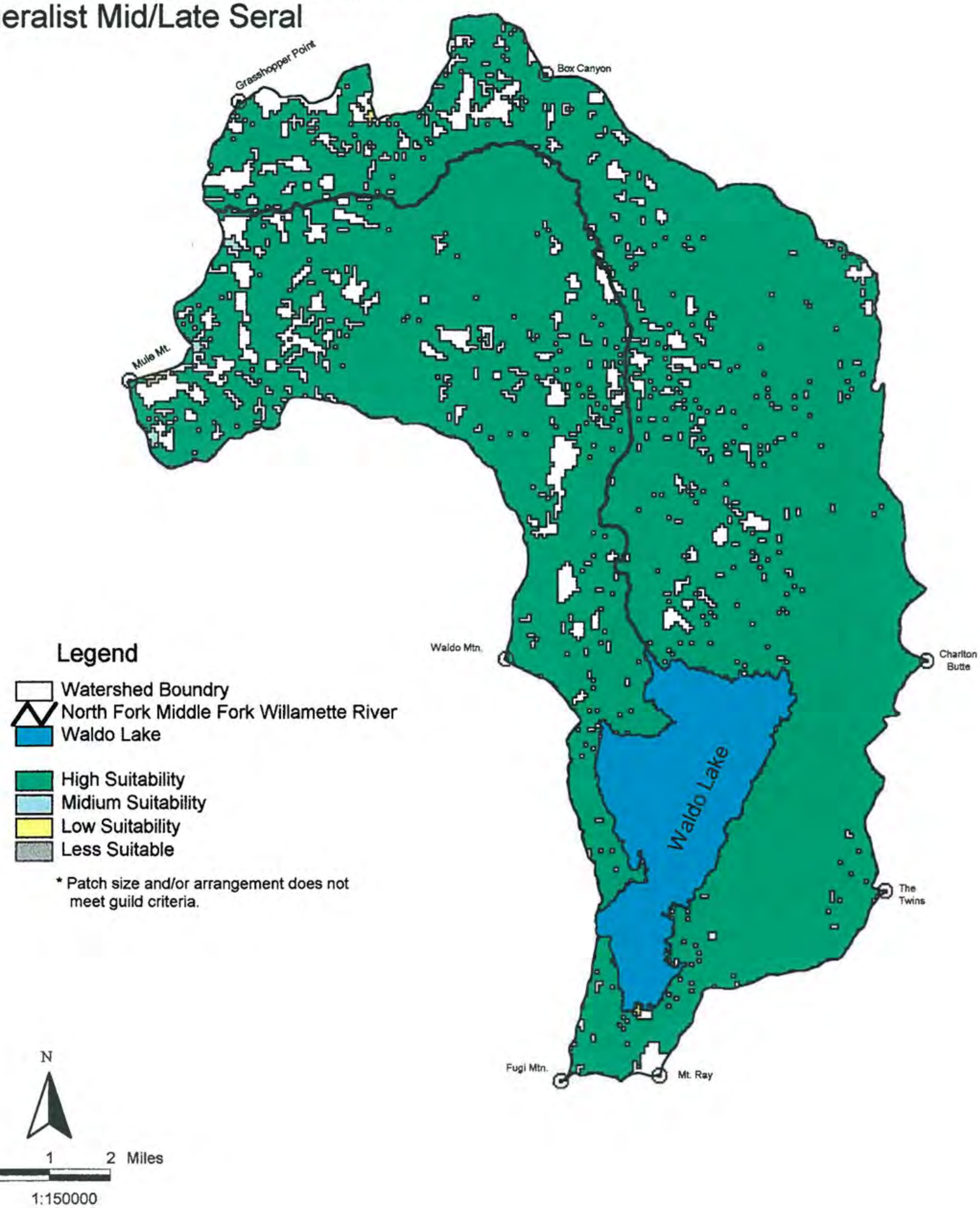


Figure: 20b
Current
Terrestrial, Small Home Range
Generalist Mid/Late Seral

Upper North Fork Middle Fork
Willamette River Watershed



APPENDIX B:

Acres Harvested On Erosive Soils

Sub-Shed	PSub	1910	1920	1930	1940	1950	1960	1970	1980	1990	Total
17-1	174	0	0	0	0	13.56	225.8	27.74	44.91	97.36	409.32
	175	0	0	0	0	0	2.53	56.53	0	3.96	63.02
	176	0	0	0	0	0	0	4.12	0	0	4.12
	177	0	0	0	0	0	0	0	12.74	40.58	53.32
	178	0	0	2.66	0	0	0	0	0	0	2.66
	17A	0	0	0	0	226.52	132.6	19.4	84.86	0	463.42
	17B	0	0	0	0	0	99.97	134.2	190.23	0	424.4
	17C	0	0	0	0	0	109.2	69.5	82.68	0	261.38
	17D	0	0	0	0	0	0	0	0	0	0
	Total	0	0	2.66	0	240.08	570.1	311.5	415.42	141.9	1681.64
17-2	171	0	0	0	0	23.87	59.31	46.57	46.08	0	175.83
	17P	0	0	0	0	0	0	0	0	0	0
	17Q	0	0	0	0	0	0	0	0	0	0
	17R	0	0	0	18.65	0	21.38	63.02	25.68	6.14	134.87
	17S	0	0	0	234.55	16.21	14.58	76.19	37.13	0	378.66
	17T	0	0	0	6.57	44.06	137.8	0	0	10.92	199.35
	17U	0	0	0	0	0	148	174	230.74	0	552.68
	17V	0	0	0	0	0	62.05	38.59	114.3	0	214.94
	17W	0	0	0	0	7.06	41.4	1.08	121.3	0	170.84
	17X	0	0	0	0	7.04	18.95	0	91.92	50	167.91
	17Y	0	0	0	0	0	0	2.67	3.44	0	6.11
	17Z	0	0	0	0	0	32.33	35.18	106.2	0	173.71
	Total	0	0	0	259.77	98.24	535.8	437.3	776.79	67.06	2174.9
17-3	179	0	0	0	70.42	162.35	201.6	217.5	174.94	0	826.82
	17J	0	0	0	0	0	0	0	0	0	0
	17K	0	0	0	0	0	0	1.12	0	0	1.12
	17L	0	0	0	19.99	0	0	39.94	31.96	0	91.89
	17M	0	0	0	35.58	169.7	392.4	238	155.8	11.63	1003.15
	17N	0	0	0	0	35.32	44.6	203.1	276.5	22.72	582.27
	17P	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	125.99	367.37	638.6	699.7	639.2	34.35	2505.25
17-4	179	0	0	0	0	0	0	0	0	0	0
	17H	0	0	0	0	218.06	124.9	38.9	137.64	0	519.51
	17I	0	0	0	0	42.72	13.52	64.6	54.79	0	175.63
	17J	0	0	0	0	184.27	90.26	261.7	122	0	658.23
	17P	0	0	0	1.53	0	2.06	0	5.46	0	9.05
	Total	0	0	0	1.53	445.05	230.8	365.2	319.89	0	1362.42
17-5	172	0	0	0	0	0	0	0	0	0	0
	173	0	0	0	0	44.85	1.06	0	8.05	0	53.96
	17D	0	0	0	0	0	54.34	93.37	101.1	0	248.81
	17E	0	0	0	0	6.74	41.21	57.26	33.98	0	139.19
	17F	0	0	0	0	0	0	0	0	0	0
	17G	0	0	0	0	10.87	196.2	22.02	208.1	0	437.19
	17H	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	62.46	292.8	172.7	351.23	0	879.15

Sub-Shed	PSub	1910	1920	1930	1940	1950	1960	1970	1980	1990	Total
24-1	24A	0	0	0	0	0	0	0	16.87	0	16.87
	24B	0	0	0	0	0	0	0	0	0	0
	24C	0	0	0	0	0	0	0	0	0	0
	24D	0	0	0	0	0	0	0	4.31	0	4.31
	24E	0	0	0	0	0	0	0	0	0	0
	24F	0	0	0	0	0	0	0	0	0	0
	24P	0	0	0	0	0	0	0	0	0	0
	24S	0	0	0	0	0	0	0	0	0	0
	24T	0	0	0	0	0	0	0	8.35	22.98	31.33
	24U	0	0	0	0	0	0	0	68.06	0	68.06
	24V	0	0	0	0	0	39.42	0	226.57	37.64	303.63
	24W	0	0	0	0	0	0	4.33	30.39	2.63	37.35
	Total	0	0	0	0	0	39.42	4.33	354.55	63.25	461.55

APPENDIX C:

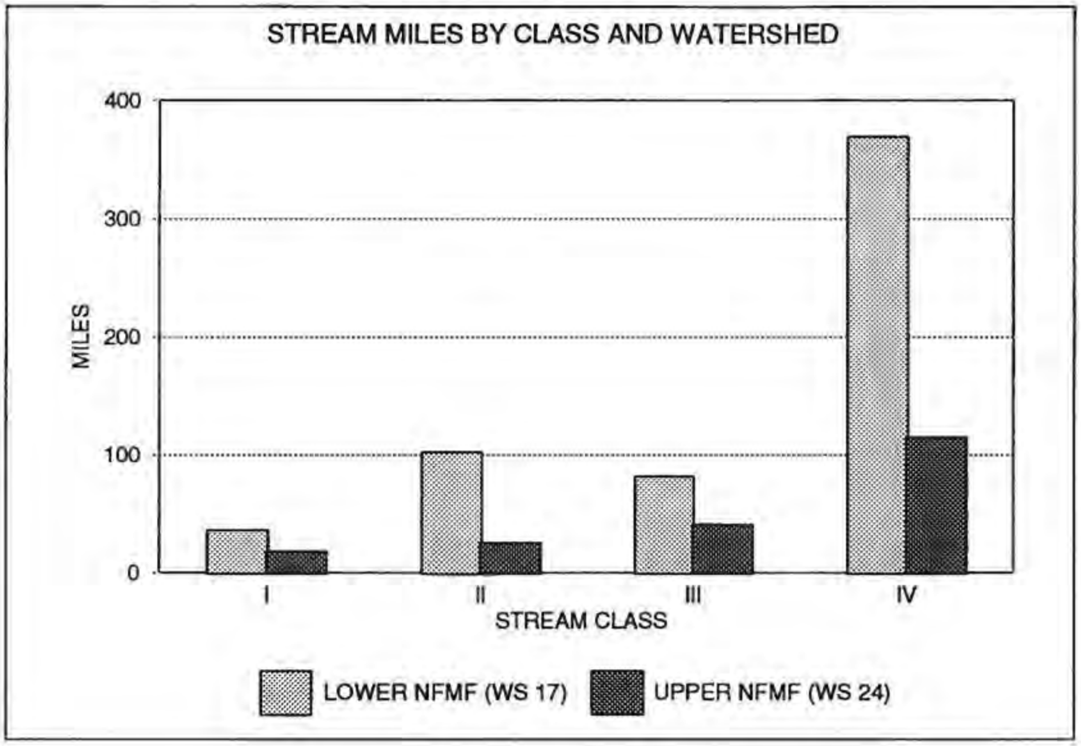
Slide Occurrence Inventory

Sub-Shed	PSub	#	Location Legal	Type	SRI	Affected Drainage	Photo Year	Elev.	Road #	Remarks
17-1	17A	8	20-3-33 NW/NE	R	15				19	
	176	11	20-4-30 SW/SE	R	212				2409-208	Cut Failure
	17C	19	20-3-26 NE/NW	R	15	NFMF			19	MP 5.35 Fill Failure
	17A	20	20-3-28 NE/SW	R	25				1910	MP 2.9 Fill Failure
	17C	21	20-3-22 SE/SW	R	201				1912	MP 2 Cut/Fill Failure
	17C	22	20-3-22 SW/SE	R	235				1912-501	Cut Failure
	17B	28	20-3-28 NW/NE	R	335				1910	Fill Failure
	17C	29	20-3-26 NE/NE	R	3				19	MP 5.22 Cut Failure
	17A	41	20-3-32 SW/SW	RDS	21	W of Short Cr	59	2800	5828-687	
	17A	42	20-3-32 NW/SW	RDS	21	W of Short Cr	59	2800	5828-687	
	17A	43	20-3-32 NW/SW	RDS	21	W of Short Cr	59	2800	5828-687	
	17A	44	20-3-32 NW/NW	RDS	21	W of Short Cr	59	2800	5828-687	
	17A	45	20-3-32 NW/NW	RDS	201S	W of Short Cr	59	2800	5828-687	
	17A	46	20-3-30 NE/SE	RDS	201	Short Cr Trib	67	2800	5828-687	
	17A	47	20-3-19 SW/NE	RDS	201	Short Cr	67	3200	5828-683	
	17B	48	20-3-19 NE/NE	RDS	25	Dartmouth Cr	67	3200	1910	
	17B	49	20-3-20 SW/NE	RDS	212	Dartmouth Cr	67	2800	1910	
	17B	50	20-3-20 SW/NE	RDS	212	Dartmouth	67	2800	1910	
	17A	51	20-3-28 NW/SE	RDS	201	NFMF	67	2200	1910	
	17B	52	20-3-28 SE/SE	RDS	201	NFMF	59	1600	1910	
	17B	53	20-3-28 NE/SE	RDS	201	NFMF	59	1600	1910	
	177	54	20-3-23 SW/SE	R	616		55		19	Cut Failure
17-2	17Q	9	19-4-30 NE/SE	R	235	NFMF	1972		19	MP 13 Cut Failure
	17Q	10	19-4-29 NW/SW	R	235	NFMF	1983		1926	Camp-5 Slide
	17Z	15	19-4-33 NE/NW	R	35		1974		1930	Fill Failure
	17Z	16	20-4-4 NW/NE	R	602				1928-706	Cut Failure
	17X	17	20-4-2 SE/SW	R	602				1930	Cut Failure
	17S	18	19-5-29 SW/NE	R	162				1940	Fill Failure
	171	30	20-4-4 SW/NE	R	602				1928-711	Cut Failure

Sub Shed	PSub	#	Location Legal	Type	SRI	Affected Drainage	Photo Year	Elev.	Road #	Remarks
17-2	17V	34	20-5-8 NE/NW	RDS	73				1934-736?	Fill Failure
	17T	36	19-5-28 SW/NW	R	162				1940	MP 0.8 Fill Failure
	17Q	67	19-4-21 SW/SW	RDS	610		59	2400	1926	
	17Q	68	19-4-28 NW/SW	RDS	3		67	2400	1926	
17-3	17L	26	19-4-12 NW/SE	R	23		1977		1927	MP 3/9 Fill Failure
	17N	27	19-5-10 SW/NE	R	602		1979		1927-703	Cut Failure
	179	70	19-5-20 NW/NE	RDS	61	Grassy Cr	59	3600	1929	Ravel +
17-4	17P	37	19-4-30 NW/SE	RDS	616	Christy Cr	67		1926-639	
	17P	38	19-4-30 SW/NW	RDS	616	Christy Cr	67		1926-639	
	17P	39	19-4-30 NW/NW	RDS	616	Christy Cr	67		1926-639	
	17P	40	19-4-30 NW/NW	RDS	616	Christy Cr	67		1926-639	
	17H	65	19-3-24 NE/NW	RDS	21	Billy Cr	59	2800	1925-654	
	17I	66	19-3-12 SW/NE	RDS	441	Purdue Cr	67	4000	1912	
	17J	69	19-4-15 NE/NE	RDS	212		81	3000	1925	
17-5	17F	23	19-3-35 SW/SW	R	35		1978		1920-662	MP 0.1 Fill Failure
	17F	24	19-3-34 SE/SE	R	35	McKinley Cr			1920	MP 2.3 Stabilized '87
	17G	25	19-3-23 SW/NW	R	301				1925-642	Sackcrete Wall
	17D	55	20-3-11 SE/SW	Nat	35	High Cr	55	2300		
	17E	56	20-3-4 SW/SW	Nat	235	Hamner Cr	59	3600		
	17E	57	20-3-4 NW/SE	Nat	212	Hamner Cr	59	2700		
	17E	58	20-3-3 SE/NW	Nat	203	Hamner Cr	59	2400		
	17E	59	20-3-2 SW/SW	Nat	201	Hamner Cr	59	2000		
	17E	60	20-3-2 SW/SE	H	35	Hamner Cr	59	1700		
17-5	17G	61	19-3-35 SW/NE	Nat	313	Chalk Cr	59	2000		
	17G	62	19-3-35 SW/NE	RDS	313	Chalk Cr	59	2000	1920-662	
	17G	63	19-3-27&28	EF	35	Chalk Cr	55	3000		
	17G	64	19-3-21	RDS	301	Chalk Cr	67	3600	1912	
	17G	71	19-3-22 NE/SW	RDS		Chalk Cr	1985		1925-642	
24-1	24V	35	20-5-2 SE/NW	R	16				1944	MP 1.55 Fill Failure

APPENDIX D:

Stream Miles By Class And Watershed And Stream Density By Subwatershed 1/



Stream Density by Subwatershed:

Subwatershed	Total Stream Miles	Miles of Stream per Square Mile
17 - 1	139.8	4.09
17 - 2	158.0	4.24
17 - 3	108.0	4.35
17 - 4	86.8	4.81
17 - 5	97.2	4.10
24 - 1	150.6	3.35
24 - 2	45.7	1.32
24 - 3	2.9	0.10

1/ Due to incomplete mapping, number of miles of Class IV streams is probably under represented.

APPENDIX E:

Current And Mid-Point Aggregate Recovery Percentages (ARP)
(by Planning Subdrainage's)

Number	Name	Mid-Point ARP	Current ARP 1/
171	Coffee	65	93
172	Tenth	65	97
173	Eight	70	99
174	Huckleberry	70	96
175	Fifth	65	98
176	Third	70	81
177	First	70	93
178	High Prairie	65	93
179	Mossy - Grassy	70	83
17A	Short - Hemlock	80	93
17B	Dartmouth	80	83
17C	Leapfrog	70	83
17D	High	80	80
17E	Hammer	80	85
17F	McKinley	80	90
17G	Chalk	80	80
17H	Evangeline	75	87
17I	Billy	70	79
17J	Nehi	70	85
17K	Sardine	70	81
17L	Christy Head	70	86
17M	Lowell	70	83
17N	Lowell Head	65	78
17P	Christy South	70	86
17Q	Flats	65	99
17R	Buffalo	70	88
17S	Major Prairie	65	93
17T	Brock	70	88

Number	Name	Mid-Point ARP	Current ARP 1/
17U	Captain	70	88
17V	Major Parker	70	86
17W	Roosevelt	70	85
17X	Devils Canyon	75	87
17Y	Hemlock	70	93
17Z	Whiterock Shale	70	88
24A	Glade	70	88
24B	Augusta	70	96
24C	Tiny	70	100
24D	Box Canyon	60	91
24E	Outer Bend	65	96
24F	Skookum	60	100
24G	Otter	60	100
24H	Erma Bell	65	100
24J	Harvey	65	100
24L	Waldo	NA	100
24M	Eddeeleo	NA	100
24N	Moolack Lake	70	100
24Q		65	100
24R		70	100
24S		65	100
24T		70	96
24U		70	85
24V		70	82
24W		75	84
24X		65	100

1/ Current ARP values may actually be lower due to incomplete vegetation information and incomplete information on area occupied by roads

APPENDIX F:

Road Density By Planning Subdrainage

Number	Name	Road Density	Number	Name	Road Density
171	Coffee	3.0	17U	Captain	3.2
172	Tenth	2.7	17V	Major Parker	3.6
173	Eight	3.5	17W	Roosevelt	4.2
174	Huckleberry	3.6	17X	Devils Canyon	2.6
175	Fifth	5.2	17Y	Hemlock	3.8
176	Third	4.6	17Z	Whiterock Shale	4.3
177	First	2.3	24A	Glade	2.9
178	High Prairie	3.9	24B	Augusta	2.6
179	Mossy - Grassy	4.1	24C	Tiny	2.2
17A	Short - Hemlock	4.6	24D	Box Canyon	4.2
17B	Dartmouth	4.0	24E	Outer Bend	4.0
17C	Leapfrog	3.5	24F	Skookum	2.1
17D	High	2.5	24G	Otter	2.5
17E	Hammer	4.2	24H	Erma Bell	1.9
17F	McKinley	3.5	24I	Pothole	1.3
17G	Chalk	3.1	24J	Harvey	1.6
17H	Evangeline	3.9	24K	Torrey	1.0
17I	Billy	4.5	24L	Waldo	1.8
17J	Nehi	4.4	24M	Eddeeleo	1.7
17K	Sardine	4.4	24N	Moolack Lake	1.7
17L	Christy Head	3.9	24Q		1.8
17M	Lowell	3.9	24R		0.4
17N	Lowell Head	3.6	24S		0.85
17P	Christy South	3.4	24T		1.0
17Q	Flats	3.3	24U		2.4
17R	Buffalo	2.6	24V		2.9
17S	Major Prairie	3.7	24W		0.46
17T	Brock	2.8			

APPENDIX G:

Aquatic Habitat And Species Lists

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED 171

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
Short	1	1.1	7	6.6	3.1	14	2.9	4.5	143	160
Dartmouth	1	.8	6	14.8	2.2	14.4	11.4	21.3	70	71.35
"	2	.3	10	15	2.6	21.5	8.4	23.3	70	70.4
"	3	1.3	9	18.1	2.3	18.1	3.6	5.4	62	58.34
"	4	.6	18							
Trib 1.06	1	.1	19	7.1		11.81			143	148.73
Trib 1.56	1	.1								
Trib 2.11	1	1	19	5.1	2	16.92	.9	1	184	207.06
Trib 2.5	1	.4	12	6.4	2.3	12	1	2.5	168	165
Trib 2.5 .16	1	.2	7	2.2		7.5			184	480
Trib 2.5 .45	1		8	3		10			184	352
First	1	.1	22	14	.5		3	19.3	75	75.43
Third	1	.2		8					132	132
"	2	.2	10	4					184	264
"	3	.2	4	4					184	264
"	4	.2		2					184	528
Fourth	1	.3	4	7	.5	8.3	10	20.8	143	150.86
"	2	.1	3	5					184	211
"	3	.2	4	5	.5		4	5.5	184	211
Fifth	1	1.8	3	4	.9		5	1.1	184	264
Seventh	1	.3	2	9	.9	6.2	32	29.2	114	117.33
Huckleberry	1	.2	11	26	.5	6.4	22	61.9	46	40.62
"	2	.5	26	22	.9	6.4	8	27.2	52	48
"	3	.3		36			0	0	37	29.33
"	4	1.5	2	16	1.1	7.6	22	7.8	68	66
"	5	.2	4	14	1.7		4	9.4	75	75.43
"	6	1.4	13	12			0	0	85	88
Trib 1	1	.3	20	5	.9		1	3.3	184	211.2
Trib 2	1	.2	12	3			0	0	184	352

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED 172

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
Trib 401	1	.4	18	2			0	0	184	528
Trib 402	1	.3	15	4			0	0	184	264
Trib 403	1	.6		3			0	0	184	352
Trib 404	1	.05	8	4			0	0	184	264
Devils Canyon	1	1.1	11	10.2	2.4	17.2	2.5	6.4	96	103.53
"	2	1.8	16	8.1	3.1	17.6	3.8	7.2	132	130.37
"	3	.5	11	3.3		20.7			184	320
"	4	small lake								
"	5	.2	10							
"	6	Huckle berry Lake								
Trib 1.13	1	.1	21	7.9		8.8			132	133.67
Cedar	1	1.5	14	8.7	2.2	22.9	1.3	4.7	114	131.38
"	2	1.2	24							
Hemlock	1	1.6	24	3.5		12.5			184	301.71

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED 173

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
Sardine	1	.5	6	14	1		5	12.6	75	75.43
"	2	.1	6	12	.7		21	31.1	85	88
"	3	.1	10	12	.6		10	27.2	85	88
"	4	.5	4	6	.5	7.6	6	3.2	168	176
"	5	.2	4	4			0	0	184	264
"	6	.2		3		9.3	0	0	184	352
"	7	.3	3	4			0	0	184	264
"	8	.5	3	5	1.4		2	3.7	184	211.2
"	9	.3	9	4		9.2	0	0	184	264
"	10	.2		2			0	0	184	528
"	11	.1	3	1			0	0	184	1056
Trib 1	1	.8	5	4			0	0	184	264
"	2									
Trib 2	1	.2	7	11	.9		11	21.6	92	96
"	2	.3	7	8	1.4	6.9	3	7.2	132	132
Trib 3	1	.3	17	4			0	0	184	1056
Trib 4	1	.2	35	4			0	0	184	264
Trib 5	1	.06	11	1			0	0	184	1056
Trib1A	1	.2	5	9	2.2		10	18.4	114	117.33
"	2	.2	8	8	2.2		7	20.5	12	
"	3	.3	6	9	2.7		2	7	114	117.33
"	4	.4	10	6			0	0	168	176
Lowell	1	.3	2	12	1.5	11.5	17	15.3	85	88
"	2	.3	2	18	.9	12.1	3	3.1	62	58.67
"	3	.2	3	19	.7	18.3	13	32.7	59	55.58
"	4	.3	4	25	1.6	9.9	11	10.4	47	42.24
"	5	.1	5	18	1.0		11	27.2	62	58.67
"	6	.1	3	21	1.1	6.5	31	53.7	54	50.29
"	7	.3		17	.9	4.2	20	30.6	65	62.12
"	8	.5	5	15	1.0	9.9	32	23.1	70	70.4
"	9	.7	4	15	1.4	8.8	30	19.5	70	70.4
"	10	1.8	5	16	1.6	9.1	19	14.7	68	66
"	11	.1	4	7	.2	16.7	3	7.6	143	150.86
"	12	.3	7	11	1.0	8.8	3	3.9	92	96
"	13	1.0	14	9	1.0	9.5	5	8.3	114	117.33
"	14	.3	14	11	.9		4	3.6	92	96
"	15	.1	11	4			0	0	184	264
Trib 1B	1	.1	4	4			0	0	184	264
"	2	.4	6	2			0	0	184	528
Mossy	1	1.1	7	8	1.5	7.4	6	6.3	132	132
"	2	.5	9	7	1.5		5	3.8	143	150.86
"	3	.2	13	6	1.1	5.5	6	8	168	176
Grassy	1	.3	4	16	1.4	5.7	30	23.7	68	66
"	2	.4	2	23	.8	8.0	9	11.6	50	45.91
"	3	.1	4	26	1.0		7	18.8	47	40.61
"	4	.9	7	18	.8		9	11.7	62	58.67
"	5	.9	5	13	.6	7.9	19	24.4	80	81.23
"	6	.4	4	8	.3	6.2	11	28.8	132	132
"	7	.9	5	9	1.1	7.6	15	32.6	114	117.33
"	8	.1	11	6	.4		14	21.5	168	176
"	9	.1	11	8	1.0	4.0	22	37.7	132	132
"	10	.4	12	5	.9	4.8	14	22.6	184	211.2
"	11	.6	13	7	1.2	8.5	2	3.5	143	150.86
"	12	.2	4	7		5.0	0	0	143	150.86
Trib 1C	1	.3	9	5			0	0	184	211.2
"	2	.1	6	5			0	0	184	211.2

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED 174

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
Billy	1	.3	25	9	1.1		6	14.2	114	117.33
"	2	.2	15	6	1.0		7	8.7	168	176
"	3	.4	4	4			0	0	184	264
Trib 1	1	1.4	9	4	.6		2	1.4	184	264
Evangeline	1	.4	11	2			0	0	184	528
Perdue	1	.8	25	12	1.6	6.1	8	12.1	85	88
"	2	.3	5	9			0	0	114	117.33
Trib 1A	1	.1	11	2			0	0	184	528
Trib 2A	1	.4	28	5			0	0	184	211.2
Nehi	1	.3	7	16	.7		12	17	68	66
"	2	.3	7	11	.5	7.7	19	28.9	92	96
"	3	.3	5	9	.6	14.4	13	30	114	117.33
"	4	2.1	7	10	.7	9.5	10	12.2	96	105.6
"	5	.4		5	.7		9	8.4	184	211.2
Trib 1B	1	.4	8	4	2.9	4	3	2.4	184	264
Trib 2B	1	.3	11	2			0	0	184	528
Trib 3B	1	.1	11	2			0	0	184	528
Trib 4B	1	.1	9	3			0	0	184	352
Trib 5B	1	.3	14	2			0	0	184	528
Trib 6B	1	.3	6	1			0	0	184	1056
Trib 1C	1	.6	10	11			0	0	92	96
"	2	.7	6	4	2.8		1	1.8	184	264

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED 175

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
High	1	.6		11.4	2.4	10.8	.8	3.3	92	92.63
"	2	1.0		9.7	2.1	21.7	1.4	4.0	96	108.87
"	3	.4		9.3	3.1	20	1.7	7.5	114	113.55
"	4	.7		8.2	2.2	8.7	1.1	2.9	132	128.78
"	5	.5		5.3		10			184	199.25
High trib	1	.9			2.4	9.7	1.2	2.2		
Hamner	1	1.0	9	11.4	2.4	18.7	8.1	14.0	92	92.63
"	2	.5		13.9	3.0	10.0	7.2	24.0	75	75.97
"	3	.4		8.7	2.4	36.0	5.1	7.5	114	121.38
"	4	.7		11.8	2.2	24.29	1.0	2.9	85	89.49
"	5	.5		4.0					184	264
Hamner Trib	1	.4	27	3.8		7.9			184	277.89
McKinley	1	.6		15.4	1.9	46.4	9.7	16.7	70	68.57
"	2	.1	8	14.9	3.1	50	12.5	30	70	70.87
"	3	.4	12	11.1	2.7	22.9	2.7	7.5	92	95.14
"	4	.4	5	10.7	3.0	9.4	2.9	7.5	92	98.68
"	5	.6	13	8.3	2.4	10.0	1.8	3.3	132	127.23
"	6	1.4		8.8	2.7	14.4	1.8	3.0	114	120
"	7	.5		3.6		13.3			184	293.33
McKinley Trib	1	.4	12	4.0		16.4			184	264
Chalk	1	.5	3	11.8	1.4		.7	2.0	85	89.49
"	2	.5	7	13.2	2.5	21.9	6.7	10.0	80	80
"	3	.7	13	12.1	2.6	21.4	14.1	30.0	85	87.27
"	4	.8	9	12.1	2.4	16.2	12.9	26.3	85	87.27
"	5	.5	15	8.3	1.9	8.8	8.3	18.0	132	127.23
"	6	.4	10	11.6	2.9	15.6	5.7	12.5	85	91.03
	7	.1	11	8.8	2.0		4.3	10.0	114	120
	8	.3	13	10.7	2.7	9.4	2.1	6.7	92	98.68
	9	.4	13	11.3	2.7	11.1	4.2	12.5	92	93.45
	10	.5	16	8.5	2.4		.8	2.0	114	124.23
17G 13.4 01.0	1	.3	15	12.9	2.4	7.4	4.3	13.3	80	81.86
"	2	.7	18	9.3	2.2	16.7	6.0	22.9	114	113.55
"	3	.7	8	7.6	2.1	13.1	.8	2.9	132	138.95
"	4	.6	13	7.6	2.2		1.0	1.7	132	138.95
17G 13.4 01.7	1	.6	28	2.0		35.8			168	528
17G 13.4 02.5	1	.5	6	10.8	2.6	12.3	2.8	8.0	92	97.78
"	2	1.4	36	9.9	2.7	11.0	8.4	2.1	96	106.67
17G 13.4 03.5	1	.6	18	4.3		12.4			184	245.58

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED 241

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
Glade	1	.3	2							
"	2	.3	2							
"	3	.5	5							
Fisher	1	1.2	2	23.1	2.3	19.9	22.6	18.3	50	45.71
"	2	2.2	2	17.7	2.2	24.0	9.8	10.0	62	59.66
"	3	1.5	3	14.5	2.2	16.4	8.3	6.0	70	72.83
"	4	.6	1	10.2	2.6		41.6	6.7	96	103.53
"	5	.4	11	9.1	2.0	12.5	4.3	5.0	114	116.04
"	6	.3	11	14.6	1.9	6.5	1.3	6.7	70	72.33
"	7	.2	14	4.0					184	264
"	8	.2	28	7.3					143	144.66
Fisher Trib	1	.6	22	10.3	2.2	14.2	.7	3.3	96	102.52
Cayuse	1	.6	3	16.0	3.3			1.7	68	66
"	2	1.3	8	9.2	1.4	8.4	1.5	4.6	114	114.78
"	3	.9	5	2.7	.9			4.4	184	391.11
"	4	.7	10	7.7	1.3	7.2	4.9	10.0	132	137.14
"	5	.4	14	6.5	1.11			10.0	143	162.46
"	6	.2	8	3.3					184	320

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED N. FORK

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
North Fork	1	4.1	2	94.0	8.6	10.2	19.9	4.4	19	11.23
"	2	2.3	2	73.3	7.6	5.9	30.0	6.1	22	14.41
"	3	2.2	2	80.7	8.6	9.4	23.9	3.6	24	13.09
"	4	2.0	2	54.0	7.4	9.9	17.8	6.0	27	19.56
"	5	2.0	3	74.6	9.3	6.3	16.3	4.5	23	14.16
"	6	.9	5	58.9	4.1	9.8	5.3	5.6	28	17.93
"	7	2.0	3	58.4	4.0	9.9	13.5	5.0	28	18.08
"	8	2.5	2	39.4	3.8	12.9	9.4	5.2	35	26.80
"	9	2.7	3	57.4	4.3	13.4	12.5	5.2	28	18.4
"	10	2.1	4	36.0	2.9	6.6	7.8	8.1	38	29.33
"	11	4.6	4	36.5	4.0	5.2	7.1	9.6	37	28.93
"	12	7.7	5	40.3	2.9	7.9	1.7	3.1	35	26.20
"	13	10.5	5	39.9	3.8	9.0	4.9	5.0	28	18.08

OBSERVED POOL VALUES AND OBJECTIVES FOR SUBWATERSHED CHRISTY

Stream Name	Reach #	Reach Length (miles)	Gradient (%)	Average Width (ft)	Residual Depth (ft)	Width/ Depth Ratio	% Area in Large Pools	Observed Large Pools /Mile	Minimum Objective PACFISH	Minimum Objective Forest Plan
Christy	1	2.3	5	39.4	5.3	10.9	10.6	10.0	35	26.8
"	2	2.4	4	39.0	4.3	8.1	18.9	9.6	35	27.08
"	3	2.3	6	38.3	3.8	8.3	14.7	17.0	36	27.57
"	4	1.7	2	24.4	2.5	7.8	14.2	17.1	49	43.28
"	5	2.1	5	15.3	1.7	7.5	9.9	25.7	70	69.02

INSTREAM LARGE WOODY MATERIAL (LWM) FOR SUBWATERSHED 171

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
Huckleberry	1	.2	52.8	26.4	10.6	37.0
"	2	.5	195.4	174.2	147.8	322.0
"	3	.3	253.4	169.0	84.5	253.5
"	4	1.5	79.2	68.6	21.1	90.7
"	5	.2	147.8	153.1	21.1	174.2
"	6	1.4	84.5	68.6	15.8	84.4
Trib 1	1	.3	174.2	200.6		200.6
Trib 2	1	.2	205.9	295.7		295.7
First	1	.1	10.6		10.6	10.6
Third	1	.2	174.2	95.0	110.9	205.9
"	2	.2	253.4	79.2	89.8	169.0
"	3	.2	332.6	79.2	42.2	121.4
"	4	.2	332.6	126.7	73.9	200.6
Fourth	1	.3	485.8	205.9	132.0	337.9
"	2	.1	792.0	169.0	63.4	232.4
"	3	.2	300.0	163.7	147.8	311.5
Fifth	1	1.8	121.4	95.0	31.7	126.7
Seventh	1	.3	190.1	142.6	79.2	221.8
Short	1	1.1	16.1	25.0	5.4	29.4
Dartmouth	1	.8	32.9	19.7	13.2	32.9
"	2	.3	49.2	49.2	42.5	91.7
"	3	1.3	34.1	33.5	21.4	54.9
"	4	.6				
Trib 1.06	1	.1	75.9	54.8	33.6	88.4
Trib 1.56	1	.1				
Trib 2.11	1	1.0	57.7	104.2	43.3	147.3
Trib 2.5	1	.4	65.1	96.4	57.9	154.3
Trib 2.5 .16	1	.2	63.5	127.1	57.8	184.9
Trib 2.5 .45	1		79.2	52.8		52.8

Note: Small is wood with 12" dbh and 25' in length
Medium is wood with 24" dbh and 50' in length
Large is wood with 36" dbh and 50' in length

INSTREAM LARGE WOODY MATERIAL (LWM) FOR SUBWATERSHED 172

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
Trib 401	1	.4	26.4	15.8	5.28	17.5
Trib 402	1	.3	279.8	142.6	95.0	237.6
Trib 403	1	.3	10.6	10.6	5.28	15.9
Trib 404	1	.05				
Devils Canyon	1	1.1	141.2	48.8	8.7	57.5
"	2	1.8	112.1	44.2	9.5	53.7
"	3	.5	8.7	4.3	7.2	11.5
"	4	small lake				
"	5	.2				
"	6	Huckleberry Lake				
Trib 1.13	1	.1	107.5	64.5	0	64.5
Cedar	1	1.5	47.3	39.9	8.6	48.5
"	2	1.2				
Hemlock	1	1.6	19.4	10.3	2.3	12.5

Note: Small is wood with 12" dbh and 25' in length
Medium is wood with 24" dbh and 50' in length
Large is wood with 36" dbh and 50' in length

INSTREAM LARGE WOODY MATERIAL (LWM) FOR SUBWATERSHED 173

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
Sardine	1	.5	142.6	68.64	47.5	116.2
"	2	1	264.0	248.2	153.1	401.3
"	3	.1	337.9	295.7	84.5	380.2
"	4	.5	47.5	42.2	5.3	47.5
"	5	.2	37.0	37.0	5.3	42.3
"	6	.2	42.2	5.3	0	5.3
"	7	.3	21.1	10.6	0	10.6
"	8	.5	89.8	52.8	5.3	58.1
"	9	.3	52.8	37.0	0	37.0
"	10	.2	0	10.6	0	10.6
"	11	.1	0	0	0	0
Trib 1	1	.8	121.4	95.0	105.8	200.1
"	2	.04				
Trib 2	1	.2	211.2	63.4	63.4	126.8
"	2	.3	137.3	42.2	5.3	47.5
Trib 3	1	.3	258.7	89.8	31.7	121.5
Trib 4	1	.2	21.1	21.1	10.6	31.7
Trib 5	1	.06	168.9	121.4		121.4
Trib 1A	1	.2	195.4	142.6	15.8	158.4
"	2	.2	200.6	110.9	5.3	116.2
"	3	.3	147.8	52.8	31.7	84.5
"	4	.4	52.8	15.8	5.3	21.1
Lowell	1	.3	63.4	89.8	58.1	147.9
"	2	.3	10.6	21.1	5.3	26.4
"	3	.2	42.2	21.1		21.1
"	4	.3	26.4	26.4	5.3	31.7
"	5	.1	10.6	26.4	15.9	42.2
"	6	.1	73.9	42.2	153.1	195.3
"	7	.3	37.0	10.6	47.5	58.1
"	8	.5	58.0	42.2	47.5	89.7
"	9	.7	63.4	58.1	89.8	147.9
"	10	1.8	15.8	15.8	10.6	26.4
"	11	.1	47.5	37.0	37.0	74.0
"	12	.3	15.8	5.3	5.3	10.6
"	13	1.0	73.9	52.8	26.4	79.2
"	14	.3	68.6	52.8	15.8	68.6
"	15	.1	227.0	147.8	89.8	237.6
Trib 1B	1	.1				
"	2	.4	31.7	10.6		10.6
Grassy	1	.3	116.2	58.1	15.8	73.9
"	2	.4	15.8	0	0	0
"	3	.1	84.5	142.6	58.1	200.7
"	4	.9	79.2	31.7	15.8	47.5
"	5	.9	10.6	10.6	5.3	15.9
"	6	.4	31.7	31.7	10.6	42.3
"	7	.9	42.2	10.6	5.3	15.9
"	8	.1	15.8	15.8	26.4	42.2
"	9	.1	68.6	31.7	15.8	47.5
"	10	.4	110.9	58.1	21.1	79.2
"	11	.6	52.8	37.0	5.3	42.3
"	12	.2	132.0	37.0	10.6	47.6
Trib 1C	1	.3	21.1	26.4	0	26.4
"	2	.1	58.1	21.1	0	21.1
Mossy	1	1.1	79.2	47.5	21.1	68.6
"	2	.5	31.7	31.7	21.1	52.8
"	3	.2	79.2	52.8	63.4	116.2

INSTREAM LARGE WOODY MATERIAL (LWM) FOR SUBWATERSHED 174

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
Billy	1	.3	644.2	501.6	607.2	1108.8
"	2	.2	248.2	327.4	158.4	485.8
"	3	.4	364.3	147.8	121.4	269.2
Trib 1	1	1.4	174.2	116.2	95.0	211.2
Evangeline	1	.4	15.8	10.6	10.6	21.2
Perdue	1	.8	248.2	184.8	73.9	258.7
"	2	.3	95.0	184.8	131.4	306.2
Trib 1A	1	.1	1805.8			
Trib 2A	1	.4	147.8	184.8	68.6	253.4
Nehi	1	.3	205.9	184.8	147.8	332.6
"	2	.3	147.8	179.5	132	311.5
"	3	.3	147.8	179.5	105.6	285.7
"	4	2.1	142.6	105.6	132	237.6
"	5	.4	73.9	105.6	110.9	216.5
Trib 1B	1	.4	63.4	31.7	5.3	36.0
Trib 2B	1	.3	79.2	68.6	58.1	126.7
Trib 3B	1	.1	73.9	10.6	10.6	21.2
Trib 4B	1	.1	100.3	73.9	26.4	100.3
Trib 5B	1	.3	290.4	169.0	126.7	295.7
Trib 6B	1	.3	31.7	79.2	63.4	142.6
Trib 1C	1	.6	89.8	89.8	31.7	121.5
"	2	.7	37.0	15.8		15.8

Note: Small is wood with 12" dbh and 25' in length
Medium is wood with 24" dbh and 50' in length
Large is wood with 36" dbh and 50' in length

INSTREAM LARGE WOODY MATERIAL (LWM) FOR SUBWATERSHED 175

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
High	1	.6	1.5	4.5	15.0	19.5
"	2	1.0	80.2	15.8	21.9	37.7
"	3	.4	79.8	53.2	39.2	92.4
"	4	.7	50.8	24.0	46.4	75.4
"	5	.5	35.7	46.5	109.1	155.6
High Trib	1	.9	43.5	22.8	34.2	57.0
Hamner	1	1.0	31.2	28.9	14.5	43.4
"	2	.5	26.4	8.3	11.1	19.4
"	3	.4	23.2	4.6	11.6	16.2
"	4	.7	29.2	1.3	22.8	24.1
"	5	.5				
Hamner Trib	1	.4				
McKinley	1	.6	14.7	12.9	36.8	49.7
"	2	.1	166.1	19.2	185.3	204.5
"	3	.4	148.8	17.5	168.5	186.0
"	4	.4	29.4	0	29.4	29.4
"	5	.6	27.9	139.5	348.8	488.3
"	6	1.4	98.8	28.9	136.9	165.8
"	7	.5	27.5	6.9	52.7	59.6
McKinley Trib	1	.4	25.7	14.3	8.6	22.9
Chalk	1	.5				
"	2	.5	68.8	15.3	10.2	25.5
"	3	.7	52.2	28.6	2.5	31.1
"	4	.8	86.0	43.6	25.5	69.1
"	5	.5	112.6	49.5	18.0	67.5
"	6	.4	127.8	67.4	32.5	99.9
"	7	.1				
"	8	.3	165.0	118.7	37.6	156.3
"	9	.4	181.4	101.9	44.7	146.6
"	10	.5				
17G 13.4 01.0	1	.3	81.0	75.6	32.4	108
"	2	.7	88.0	47.1	12.6	59.7
"	3	.7	62.0	38.9	17.0	55.9
"	4	.6				
17G 13.4 01.7	1	.6				
17G 13.4 02.5	1	.5	125.4	87.3	24.6	169.0
"	2	1.4	77.0	81.7	27.5	109.2
17G 13.4 03.5	1	.6	60.8	59.4	7.2	66.6

Note: Small is wood with 12" dbh and 25' in length
Medium is wood with 24" dbh and 50' in length
Large is wood with 36" dbh and 50' in length

INSTREAM LARGE WOODY MATERIAL (LWM) FOR SUBWATERSHED 241

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
Glade	1	.3				
"	2	.3				
"	3	.5				
Fisher	1	1.1	48.8	29.9	22.0	51.9
"	2	2.2	27.2	11.0	5.2	15.2
"	3	1.5	11.8	4.2	0	4.2
"	4	.6	17.5	5.0	2.5	7.5
"	5	.4	35.2	7.0	3.5	10.5
"	6	.3	2.2	0	6	0
"	7	.2				
"	8	.2				
Fisher Trib	1	.8	47.7	38.8	6.0	104.8
Cayuse	1	.6	116.0	36.1	23.2	59.3
"	2	1.3	70.6	47.0	33.6	80.6
"	3	.9				
"	4	.7	46.3	29.9	9.0	38.9
"	5	.4	128.6	62.3	19.5	81.8
"	6	.2				

Note: Small is wood with 12" dbh and 25' in length
Medium is wood with 24" dbh and 50' in length
Large is wood with 36" dbh and 50' in length

INSTREAM LARGE WOODY MATERIAL (LWM) FOR THE MAIN STEM NORTH FORK

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
North Fork	1	4.1	1.9	1.0	.2	1.2
"	2	2.3	9.1	3.0	.9	3.9
"	3	2.2	4.5	1.0	0	1.0
"	4	2.0	9.5	2.5	2.5	5.0
"	5	2.0	5.0	.5	0	.5
"	6	.9	81.1	22.2	4.4	26.6
"	7	2.0	27.5	5.5	1.0	6.5
"	8	2.5	53.2	18.0	11.2	29.2
"	9	2.7	8.5	11.5	2.6	13.1
"	10	2.1	2.3	21	26	47
"	11	4.6	41	27	35	62
"	12	7.7	13	16	13	29
"	13	10.5	13	14	14	28

INSTREAM LARGE WOODY MATERIAL (LWM) FOR THE
MAIN STEM OF CHRISTY CREEK

Stream Name	Reach #	Reach Length	# Small LWM	# Medium LWM	# Large LWM	Number of Med. + Large LWM / Mile
Christy	1	2.3	50.9	15.7	6.5	22.2
"	2	2.4	25.8	35.8	10.0	45.8
"	3	2.3	82.2	60.0	23.0	83.0
"	4	1.7	22.4	37.7	14.7	52.4
"	5	21	94.8	22.9	12.4	35.3

Note: Small is wood with 12" dbh and 25' in length
Medium is wood with 24" dbh and 50' in length
Large is wood with 36" dbh and 50' in length

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED 171

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
Short	1	1.1	5	GR	CO	Fair	3 (25x20)	4
Dartmouth	1	.8	6	CO	SB	Good	4 (40x100)	2
"	2	.3	2	SB	CO	Good	0	3
"	3	1.3	3	CO	GR	Good	2 (50x20)	2
"	4	.6	3	CO	GR	Good	2	1
Trib 1.06	1	.1	2	BR	GR	Excellent	0	3
Trib 1.56	1	.1	2	BR	BR	Good	0	
Trib 2.11	1	1.0	3	CO	GR	Good	0	4
Trib 2.5	1	.4	3	GR	CO	Good	2 (50x20)	0
Trib 2.5 .16	1	.2	3	GR	CO	Fair	0	1
Trib 2.5 .45	1		3	GR	CO	Good	0	
Huckleberry	1	.2	2	BO	RU	Good		
"	2	.5	3	BO	RU	Fair		4
"	3	.3	3	LB	BR	Fair		
"	4	1.5	6	CO	GR	Good		2
"	5	.2	6	GR	CO	Good		4
"	6	1.4	8	CO	GR	Good		1
Trib 1	1	.3	8	CO	GR	Fair		3
Trib 2	1	.2	8	GR	BR	Fair		5
First	1	.1	8	LB	RU	Good		
Third	1	.2	3	RU	LB	Good		8
"	2	.2	6	GR	SA	Good		
"	3	.2	6	SA	CO	Fair		3
"	4	.2	8	CO	SA	Fair		6
Fourth	1	.3	6	GR	BO	Fair		
"	2	.1	6	SA	CO	Good		2
"	3	.2	6	SA	GR	Fair		8
"								
Fifth	1	1.8	6	SA	GR	Fair		55
Seventh	1	.3	6	SA	CO	Fair		1

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED 172

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
Trib 401	1	.4	8			Good		
Trib 402	1	.3	8	CO	RU	Good	21	1
Trib 403	1	.6	8	RU	BR	Fair		
Trib 404	1	.05	8			Fair		
Devils Canyon	1	1.1	8	CO	SB	Fair	? (50X12)	
"	2	1.8	2	BR	CO	Good	7 (30X30)	3
"	3	.5	3	GR	CO	Fair		1
"	4	small lake						
"	5	.2	4			Good		1
"	6	Huckle-berry Lake						
Trib 1.13	1	.1	3	CO	LB	Good	3 (10X5)	0
Cedar	1	1.5	4	CO	GR	Poor	12 (50x15)	2
"	2	1.2	3	SB	CO	Good	1 (70x30)	2
Hemlock	1	1.6	4	CO	SB	Good	1 (30x12)	1

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED 173

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
Sardine	1	.5	6	CO	RU	Good		5
"	2	.1	6	BO	RU	Good		0
"	3	.1	6	RU	BO	Fair		4
"	4	.5	6	RU	CO	Good		0
"	5	.2	6	CO	RU	Good		0
"	6	.2	6	CO	RU	Fair		
"	7	.3	6	RU	CO	Fair		
"	8	.5	8	GR	CO	Good		
"	9	.3	8	GR	RU	Fair		
"	10	.2	8	CO	RU	Good		
"	11	.1	8	CO	GR	Good		
Trib 1	1	.8	6	CO	RU	Good		3
"	2	.04	6			Good		
Trib 2	1	.2	6	RU	BO	Fair		4
"	2	.3	6	CO	RU	Good		3
Trib 3	1	.3	8	WO	GR	Fair		
Trib 4	1	.2	8	CO	RU	Fair		
Trib 5	1	.06	8	WO	GR	Fair		
Trib 1A	1	.2	10	CO	RU	Fair		
"	2	.2	5	CO	BO	Fair		7
"	3	.3	6	CO	GR	Fair		30
"	4	.4	8	BR	RU	Fair		34
Lowell	1	.3	6	CO	RU	Fair		
"	2	.3	6	RU	BO	Fair		2
"	3	.2	6	BO	RU	Fair		
"	4	.3	6	RU	BO	Fair		2
"	5	.1	6	BO	RU	Fair		
"	6	.1	6	RU	CO	Fair		
"	7	.3	6	RU	CO	Fair		2
"	8	.5	6	RU	CO	Fair		2
"	9	.7	6	RU	CO	Poor		5
"	10	1.8	6	RU	CO	Fair	1 (30X50)	
"	11	.1	10	BO	RU	Good	1 (15X10)	
"	12	.3	10	RU	BO	Good		
"	13	1.0	8	BO	LB	Fair		
"	14	.3	8	RU	BO	Fair		many
"	15	.1	8	RU	GR	Fair		
Trib 1B	1	.1	8	CO	RU	Good		
"	2	.4	8	BR	SA	Fair		2
Mossy	1	1.1	6	RU	BO	Fair		
"	2	.5	6	BO	RU	Fair		
"	3	.2	8	CO	BO	Fair		3

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PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED 173

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
Grassy	1	.3	6	RU	BO	Good		2
"	2	.4	6	BO	RU	Fair		
"	3	.1	6	RU	CO	Good		
"	4	.9	6	RU	BO	Fair		6
"	5	.9	6	RU	BO	Good		
"	6	.4	10	CO	RU	Good	1 (20X50)	3
"	7	.9	10	BO	CO	Good	2 (35X70)	3
"	8	.1	8	BO	LB	Good		1
"	9	.1	8	BO	CO	Good		2
"	10	.4	8	BR	BO	Good		
"	11	.6	8	RU	GR	Good		20
"	12	.2	8	CO	GR	Good		1
Trib 1C	1	.3	8	CO	GR	Fair		
"	2	.1	8	GR	CO	Fair		

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED 174

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
Billy	1	.3	4	BO	BR	Fair		97
"	2	.2	6	CO	BO	Good		15
"	3	.4	10	CO	GR			
Trib 1	1	1.4	6	RU	BO	Fair		
Evangeline	1	.4	4	BO	CO	Good		
Perdue	1	.8	4	RU	LB	Good		
"	2	.3	4	GR	CO	Fair		2
Trib 1A	1	.1	8	CO	GR	Good		
Trib 2A	1	.4	8	CO	SA	Fair		
Nehi	1	.3	5	RU	BO	Fair		7
"	2	.3	3	LB	BO	Fair		3
"	3	.3	10	BR	RU	Fair		7
"	4	2.1	10	RU	BO	Fair		5
"	5	.4	10	RU	CO	Fair		4
Trib 1B	1	.4	8	CO	GR	Fair		
Trib 2B	1	.3	8	RU	CO	Fair		
Trib 3B	1	.1	8	SA	CO			
Trib 4B	1	.1	8	SA	CO	Fair		
Trib 5B	1	.3	6	RU	CO	Fair		
Trib 6B	1	.3	6	GR	CO	Fair		6
Trib 1C	1	.6	8	CO	RU	Good		
"	2	.7	8	SA	CO	Fair		

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED 175

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
High	1	.6	3	CO	GR	Good	3 (100x20)	
"	2	1.0	2	CO	SB	Fair	9 (250x35)	5
"	3	.4	3	GR	CO	Fair	3 (100x25)	8
"	4	.7	3	GR	CO	Fair	5 (100x65)	8
"	5	.5	3	GR	CO	Fair	2 (35x25)	8
High Trib	1	.9	3	GR	CO	Fair	4 (140X35)	10
Hamner	1	1.0	5	GR	CO	Good	2 (30x25)	4
"	2	.5	3	CO	GR	Fair	2 (60x25)	5
"	3	.4	5	GR	CO	Fair	3 (100x25)	6
"	4	.7	5	CO	GR	Fair	19 (150x25)	3
"	5	.5	5	GR	GR			
Hamner Trib	1	.4	3	CO	SA	Fair	1 (20x25)	10
McKinley	1	.6	3	CO	BR	Fair	1	2
"	2	.1	6	CO	GR	Fair	1	3
"	3	.4	3	CO	SB	Good		
"	4	.4	6	CO	SB	Fair	1 (29x20)	3
"	5	.6	2	CO	SB	Fair	4 (20x10)	5
"	6	1.4	3	CO	SB	Fair	1	14
"	7	.5	3	GR	SA	Good		2
McKinley Trib	1	.4	4	GR	CO	Good	7 (12x15)	10
	1	.5	8	CO	GR	Fair		4
Chalk	2	.5	3	CO	SB	Fair		2
"	3	.7	3	CO	BR	Fair	3 (100x40)	1
"	4	.8	3	GR	CO	Good	4 (100x30)	7
"	5	.5	5	GR	CO	Fair	3 (300x40)	6
"	6	.4	6	GR	CO	Fair	4 (50x30)	5
"	7	.1	5	GR	CO	Good	1 (40x20)	1
"	8	.3	5	GR	CO	Fair	5 (50x30)	3
"	9	.4	3	GR	CO	Good	1 (50x15)	3
"	10	.5	3	GR	CO	Good		2
17G 13.4 01.0	1	.3	3	CO	SB	Good	1 (20x7)	2
"	2	.7	2	GR	CO	Fair	2 (20x5)	4
"	3	.7	3	GR	CO	Good	2 (25x10)	4
"	4	.6	3	GR	CO	Good	1 (40x20)	2
17G 13.4 01.7	1	.6	3	CO	SB	Fair	5 (50x15)	
17G 13.4 02.5	1	.6	3	GR	CO	Fair	10 (50x20)	3
"	2	1.4	3	GR	CO	Poor	20 (100x25)	1
17G 13.4 03.5	1	.6	3	GR	CO	Fair	5 (100X15)	2

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED 241

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
Glade	1	.3	6	CO	GR	Good		6
"	2	.3	7	CO	SA	Fair		30
"	3	.5	7	CO	GR	Good		
Fisher	1	1.1	7	GR	CO	Good	1 (50x17)	5
"	2	2.2	7	GR	CO	Good	2 (20x30)	2
"	3	1.5	5	GR	CO	Fair	1 (50x20)	5
"	4	.6	9	GR	SA	Good		2
"	5	.4	10	GR	CO	Good		
"	6	.3	5	CO	SB	Good		
"	7	.2	8	GR	CO	Good		
"	8	.2	8	CO	SB	Good		
Fisher Trib	1	.6	2	GR	CO	Good	3 (50X10)	
Cayuse	1	.6	5	CO	SB	Good		
"	2	.3	5	CO	SB	Good		2
"	3	.9	5	CO	SB	Fair		4
"	4	.7	5	CO	SB	Good		10
"	5	.4	5	BR	GR	Good		
"	6	.2	5	GR	CO	Good		

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED NORTH FORK

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
North Fork	1	4.1	1\10	CO	BR			
"	2	2.3	3	CO	BR			
"	3	2.2	10	CO	GR			
"	4	2.0	3	CO	GR			
"	5	2.0	3	CO	GR			
"	6	.9	3	CO	SB			
"	7	2.0	6	CO	GR			
"	8	2.5	10	CO	GR			
"	9	2.7	10	GR	CO			
"	10	2.1	10	CO	GR			
"	11	4.6	10	CO	SB			
"	12	7.7	7	SB	LB			
"	13	10.5	7	CO	CO			

PHYSICAL INFORMATION FOR STREAMS LOCATED IN SUBWATERSHED CHRISTY

Stream Name	Reach #	Reach Length (miles)	Valley Segment Type	Dominant Substrate	Subdominant Substrate	Channel Stability Rating	# Failures (average) (size)	# Debris Jams
Christy	1	2.3	3	CO	SB			
"	2	2.4	4	GR	CO			
"	3	2.3	3	CO	CO			
"	4	1.7	6	GR	CO			
"	5	2.1	6	CO	GR			

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 171

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
Short	7/21/94	1	SP	100	HB, HA	SP,LT	50,50	CD/CC, CC/CD	57 (1045)	CT, SCULPIN	
Dartmouth	7/7/94	1	SP,ST	67, 33	HA/CC, HA	ST,LT	17,83	CD/CH, CD/CD	54 (1245)	Trout	
•		2	SS,SP	50, 50	HV/HA, HA, HV	ST,LT	50,50	HV/CD, CD/HB	49 (0830)	Trout	
•		3	SS,SP, ST	60, 20, 20	HA/HB, HA/HB, HB/HA	ST,LT	25,75	CH/CC, CD/CC	54		
•		4									
Trib 1.06		1	SP	100	HB/CY, HV,HA	LT	100	CD/HV	53 (1600)		DIEN
Trib 1.56		1									
Trib 2.11		1	SS	100	HV/HX	ST/LT	75,25	CC/CH, CH/CC	57 (1330)		
Trib 2.5		1	SS	100	HV/CD	ST/LT	50,50	CH/CD, CC/CH	55 (1300)		
Trib 2.5 .16		1	SS	100	HB/HA	MT	100	CD/CC	56 (1630)		
Trib 2.5 .45		1							52 (1445)		
Unnamed										CT	
Huckleberry	7/9/91	1	MT	100					53.6		
•		2	MT	100					53.6		
•		3							55.4		
•		4	MT	100					48.2	Trout	
•		5							50.0	Trout	
•		6							42.8	CT	
Trib 1		1							48.2	Trout	
Trib 2		1							48.2		
First	7/10/91	1								Trout	
Third	7/10/91	1							51.8		
•		2									
•		3							51.8	Trout, CT	
•		4									
Fourth	7/31/91	1	ST	100					51.8	Trout	TAGR
•		2							51.8	Trout, CT	
•		3							53.6		
Fifth	7/25/91	1							51.8	CT	
Seventh	7/18/91	1	SP/LT	74, 26					51.8	CT	
Sixth	8/2/94								54 (1515)	CT	

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 172

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
Trib 401	8/10/91	1									
Trib 402		1							54	Trout	
Trib 403		1									
Trib 404		1									
Devils Canyon	7/26/94	1	GF/SS/ ST	25,25, 50	GF/HV, HV/HB, HV/HC	GF/ST/ LT	6,72,22	GF/CD, CD/CH, CD/CD	56 (1510)	Trout	
"		2	SS/ST/ LT	33,33, 33	HV/HB, HV/CH, CD/CC	ST/LT	33,67	CD/CD, CD/CC	54 (1437)	Trout	DIEN, THEL, ASTR
"		3				ST/LT	50,50	CH/CH	56 (1515)		
"		4									
"		5									
"		6									
Trib1.13		1	MT	100					47 (1000)		
Cedar		1	SS/SP/ ST	17,67, 17	HV/CC, HA/HV, HA/HA	SS/ST/ LT	9,45,45	CH/CC, CD/CD, CD/CH	54 (1445)	Trout, CT	DIEN
"		2									
Hemlock		1	SP	100	HA/HA	ST/LT	50,50	CH/CC, CH/CD	48 (1225)		DIEN, TAGR
Captain	9/8/94									CT	
Major	9/7/94									CT	
Shale	8/3/94									CT	
Brock	9/6/94									CT	

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 173

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
Sardine	8/29/91	1	MT,ST, SP,LT	5,53,22, 20					54	Trout	DIEN
"		2	MT,ST, SP,LT	4,65,27, 4					54	Trout	
"		3	MT,ST, SP	4,67,28					50	Trout	Frog
"		4	ST,SP	70,30						Trout	
"		5	ST,SP	76,24							
"		6	ST,SP	73,27							
"		7	ST,SP	85,15						CT	
"		8	ST,SP	80,20						CT	
"		9	ST,SP	60,40							
"		10	SP	100							
"		11									
Trib 1		1								Trout	
"		2									
Trib 2		1									
"		2								Trout	
Trib 3		1								Trout	
Trib 4		1									
Trib 5		1									
Trib 1A	10/16/92	1									
"		2									
"		3								Trout	
"		4								Trout	
Lowell	7/16/90	1	LT	100					64.4	Trout	
"		2	ST	100					55.4	Trout	
"		3	MT	100					55.4	CT	
"		4	SS/SP	46,54					60.8		
"		5							62.6	Trout	
"		6	SS	100					59.0		
"		7	SS	100					59.0		
"		8	SS/SP	49,51					55.4	Trout	
"		9	SS	100					53.6		DIEN
"		10	SS/ST	62,38					55.4	Trout, CT	
"		11	LT	100					57.2		DIEN, AMMA
"		12	SS	100					60.8	Trout	
"		13	MT	100					53.6	Trout	DIEN
"		14							53.6	Trout	
"		15							53.6		
Trib 1B	9/29/92	1									
"		2									

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BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 173

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
Mossy	8/1/90	1	MT	100					55.4		
"		2							57.2	Trout, CT	Salamander THEL
"		3	MT	100					59.0	Trout	
Grassy	6/27/90	1	GF,SS, ST	36,22, 42					51.8	Trout	
"		2	SS/ST	84,16					51.8	CT	
"		3							51.8		
"		4							51.8		
"		5	ST	100					53.6		
"		6	ST	100					51.8	Trout	
"		7	ST/SP, LT	56,37,7					51.8	Trout	THEL
"		8							55.4		
"		9	ST	100					57.2	Trout	DIEN
"		10	ST	100					59.0	Trout	Frog
"		11	MT	100					60.8	Trout	
"		12	ST	100					60.8	Trout	DIEN
Trib1C	10/8/92	1									
"		2									

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 174

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
Billy	8/7/91	1								Trout	
"		2									
"		3									
Trib 1	10/4/91	1							53.6		
Evangeline	8/6/91	1							53	Trout, CT	DIEN, RACA
Perdue	8/14/91	1	GF/MT	66,34					55.4		
"		2							57.2		
Trib 1A	9/3/91	1							50 (1035)		DIEN, AMGR
Trib 2A	10/2/92	1									
Nehi	9/16/91	1							51.8	Trout	
"		2	SS	100					55.4	Trout, CT	DIEN
"		3	SS	100					53.6	Trout	DIEN
"		4	SP/SS	64,36					51.8	Trout	
"		5									
Trib 1B	9/19/91	1	SS	100					53.6	Trout	
Trib 2B	9/19/91	1							53.6		
Trib 3B	9/19/91	1							53.6		
Trib 4B	9/19/91	1									
Trib 5B	9/19/91	1							51.8		
Trib 6B	9/19/91	1								Trout	
Trib1C	10/21/92	1									
"		2									

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 175

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
High	11/1/93	1	ST,LT	50,50	CD/HA, CD				45 (1230)	RB	
•		2	ST,LT	67,33	CC/CH, CD/CH				45 (1355)		ASTR, DIEN
•		3	LT	100	CD/CH				44 (1105)	Trout	
•		4	SP,LT	50,50	CD, CD/CC				45 (1445)		
•		5	LT	100	CD/CH				41 (1320)		
Trib to High	11/9/93	1	ST/LT	67,33	CD/CH, CD/CH				45 (1515)		
Hamner	8/31/93	1	ST,LT	50,50	HA/CD, CD/CH				54 (1430)	CT,SC	RAAU, DIEN, Tadpole
•		2	SP	100	HA/CD				53 (1400)	CT	
•		3	MT	100	CD/CC					Trout	
•		4	ST	100	CH/HA				51 (0935)		
		5									
Trib to Hamner	9/4/93	1	SS,SP	40,60	HA/HA, HA/HA				54 (1110)		
McKinley	7/7/93	1	SP	100	HA/HA				55 (1500)	Trout	RAAU
•		2	SP	100	HA/HA				54 (1500)	Trout	ESDU
•		3	MT	100	CC/HA						TAGR, RAAU, DIEN
•		4	ST	100	HA/CD				54 (1100)		ESDU
•		5	ST	100	CD/CC				52 (1200)		RAAU
•		6	MT	100	CD/CC				50 (1500)		
•		7	MT	100	CD/CH				52 (1100)		
Trib to McKinley	7/28/93	1							55 (1200)		
Chalk	7/28/93	1								RB, SC	DIEN
•		2	SP	100	HA/HV				60 (1500)	RB,CT, SC	DIEN, Tadpole
•		3	ST	100	CH/CD				65 (1335)	Trout	
•		4	GS/SS/ ST/MT	20,20,2 0,40	GF/CH, HA/HA, CC/HV, CC/CC				67 (1530)	CT	DIEN, RAAU
•		5	SS	100	HA/CD				59 (1145)	Trout	
•		6	ST/LT	50,50	CC/HA, CD/CC				60 (1530)	Trout	
•		7								Trout	
•		8	LT	100	CD/CH				56 (1315)	Trout	
•		9	MT	100	CD/CH				49 (1030)	Trout	
•		10									

(subwatershed 175 continued on next page)

(subwatershed 175 continued from previous page)

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 175

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
17G 13.4 01.0	10/4/93	1	GF/SP/ ST	20,40,4 0	GF/GF, HA/HB, CY/HB				54 (1130)	Trout	
"		2	ST/LT	77,23	CD/CD, CC/HV				54 (1230)		
"		3	SS/SP/ MT	33,33,3 3	HA/CD, CD/HA, HV/CD				52 (1230)		
"		4									
17G 13.4 01.7	9/28/93	1	GF	100	GF/GF				67 (1345)		Frog
17G 13.4 02.5	10/18/93	1	SP/ST	75,25	HA/HA, CD/CH				47 (1010)	Trout	
"		2	SP/ST/ LT	20,20,6 0	HA/HA, CH/CC, CD/CC				50 (1330)	Trout	
17G 13.4 03.5	9/27/93	1	LT	100	CD/CC						

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED 241

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
Glade	7/17/92	1									
		2								Trout, CT	Salamander
		3									
Fisher	8/23/93	1	SP/MT	17,83	HA/CC, CC/CD				50 (1155)	CT, SC	
		2	SS/LT/ MT	14,29, 57	HV/CD, HA/CD, CC/CD				49 (1530)	CT,SC	
		3	SS/SP/ ST/LT	20,40, 20,20	HV/CD, HA/CD, HA/CD, CD/CH				47 (1245)	CT,SC	
		4	SP	100	HA/CD				45 (1310)	Trout	Tadpole
		5	MT	100	CC/HB				46 (1205)	Trout	Tadpole
		6	LT	100	CD/CH				44 (1550)		
		7									HYRE
		8									Salamander THEL
Trib to Fisher		1	SP/LT	83,17	HA/HB, CD/CC				46 (1317)	Trout below culvert	
Cayuse	7/11/92	1	ST	100	HA/HM						
		2	LT	100	CD/CC						
		3									
		4	MT	100	CD/CH				47 (1230)	CT	
		5	MT	100	CD/CH				45 (1300)		
		6									
Minute	9/6/94									CT	
Box Canyon	9/6/94									CT	

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED NORTH FORK

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
North Fork	8/26/91	1	ST	100	HA/CD	ST/LT	91,9	CD/HB, CD/CD	62	RB, CT	
"		2	SP/ST	20,80	HA/HB, CD/HA	ST	100	CD/CB		RB, CT	
"		3	SP/ST	25,75	HA/CD, HA/CD	ST/LT	75,25	CD/CH, CD/CC		RB, CT	
"		4	ST	100	HA/CD	ST	100	CD/HB	63	RB, CT	
"		5	SP/ST	25,75	HA/CD, HA/CD	ST	100	CD/CH		RB, CT	
"		6	ST	100	HA/CD	ST	100	CD/CC	59	RB, CT	
"		7	SP/ST	33,67	HA/HB, HA/CD	ST/LT	83,17	CD/CH, CD/CH	48	RB, CT	
"		8	SP/ST	36,64	HA/CD, HA/CH	ST/LT	55,45	CH/CD, CD/CH		RB, CT	
"		9	SP/ST	36,64	HA/HC, HA/HC	ST/LT	36,64	CD/HB, CD/CH		RB, CT	
"		10	SP/ST/ MT	68,6, 25	HA/HV, HA/HX, CD/CX	SP/LT/M T	25,25,5 0	HA/HV, CD/CX, CD/CX	55	RB, CT	
"		11	SP/ST/ LT	64,29, 5	HA/HX, HB/HX, HC/HX	LT	94	CD/CX	57		
"		12	SP/ST/ MT	75,16, 8	HB/HA, HA/HX, CD/HB	ST/LT	8,75	HA/HX, CD/CX	53		
"		13	SP/MT	70,30	HA/HX, HB/HX	LT/MT	70,10	CD/CX, CD/CX	53	RB, CT	

BIOLOGICAL INFORMATION ABOUT SPECIES LOCATED IN THE RIPARIAN AREA OF SUBWATERSHED CHRISTY

Stream Name	Survey Date	Reach #	Seral Stage (% Inner Riparian)	Percent Inner Riparian	Inner Riparian Species	Seral Stage (% Outer Riparian)	Percent Outer Riparian	Outer Riparian Species	Water Temp. Deg. F (Time)	Fish Species	Amphibian Species
Christy	7/15/91	1	SP/ST	25,75	HA/CH, HA/CH	ST/LT	63,38	CD/CC, CD/CH	56	CT, SC, Dace	
"		2	GF/SP/ ST	11,11, 78	HX/HA, HA/CD, HA/CC	ST/LT	22,78	CD/CD, CD/CH		CT	
"		3	GF/SP/ ST	6,24, 71	HX/HA, HA/HA, HA/HA	ST/LT	35,65	CD/CH, CD/CH		CT	
"		4	SP/ST/ LT	50,42, 8	HA/CD, CH/HA, CH/CC	ST/LT	50,50	CD/CH, CD/CH	61	CT	
"		5	SS/SP/ ST/LT	6,24, 53,12	HW/HV, HA/HV, CD/CH, CC/CH	SP/ST/ LT	24,24, 53	CD/HV, CD/CH, CD/CH		CT	

STREAMS SURVEYED IN THE NORTH FORK WATERSHED

Stream Name	Sub-watershed	PSUB	Miles Surveyed	Year Surveyed	Method
Short	Westfir (171)	17A	1.1	7/21/94	SMART
Dartmouth	Westfir (171)	17B	4.8	7/07/94	SMART
Huckleberry	Westfir (171)	173	4.6	7/09/91	GP
First & Second	Westfir (171)	177	.1	7/31/91	GP
Third & Fourth	Westfir (171)	176	1.4	7/10/91	GP
Fifth, Sixth, & Seventh	Westfir (171)	175	2.1	7/18/91	GP
Devils Canyon	Devil's Canyon (172)	17X	3.7	7/26/94	SMART
Cedar	Devil's Canyon (172)	17Y	2.7	9/06/94	SMART
Hemlock	Devil's Canyon (172)	17Y	1.6	9/12/94	SMART
Misc. Tribs	Devil's Canyon (172)	17S	1.4	8/10/91	GP
Misc. Tribs	Devil's Canyon (172)	17L	1.1	10/16/92	GP
Sardine	Upper Christy Creek (173)	17K	4.9	8/29/91	GP
Lowell	Upper Christy Creek (173)	17M+N	6.9	7/16/90	GP
Grassy	Upper Christy Creek (173)	179	5.7	6/27/90	GP
Mossy	Upper Christy Creek (173)	179	1.8	8/01/90	GP
Billy	Lower Christy Creek(174)	17H	2.3	8/07/91	GP
Evangiline	Lower Christy Creek (174)	17H	.4	8/06/91	GP
Perdue	Lower Christy Creek(174)	17I	1.6	8/14/91	GP
Nehi	Lower Christy Creek (174)	17J	4.9	9/16/91	GP
Misc. Tribs	Lower Christy Creek(174)	17J	1.3	10/21/92	GP
Christy	NA	NA	10.8	7/15/91	SMART
High	N. Fork Middle Fork Willamette (175)	17D	4.1	11/01/93	SMART
Hammer	N. Fork Middle Fork Willamette (175)	17E	3.5	8/31/93	SMART
McKinley	N. Fork Middle Fork Willamette(175)	17F	4.4	7/07/93	SMART
Chalk	N. Fork Middle Fork Willamette (175)	17G	10.1	7/28/93	SMART
Glade	Fisher Creek(241)	24A	1.1	7/17/92	SMART
Fisher	Fisher Creek (241)	24P	7.1	8/23/93	SMART
Cayuse	Fisher Creek(241)	24W	4.1	7/01/92	SMART
North Fork	NA	NA	45.6	8/26/91	SMART

APPENDIX H:

Botanical Resources

POTENTIAL SENSITIVE PLANT HABITATS

The Regional Forester designates a list of species for which they and their habitat is managed by the Region's Sensitive Species Program in order to prevent a need for federal listing at a future date. Sensitive species are those that are vulnerable due to low population levels or have significant threats to their habitat (USFS, R-6 FSM). Known population locations are on the Oakridge GIS system and population information is contained in an associated advanced revelation (ADREV) database. Sensitive plant surveys which are done in the watershed are generally associated with proposed management activities (timber sales and other projects).

Two plants on the sensitive list have documented populations within the watershed. These two sensitive plants are found in non-forested meadow and meadow edge habitats.

Mesic to dry meadow openings in mid-elevation Abies dominated forests are prime habitat for the Umpqua swertia (Frasera umpquaensis). This sensitive species is federally listed by the USFWS as a Candidate 2 species for which further information is necessary to be able to propose the plant as Threatened or Endangered. It is an ODA protected Candidate List 1 Endangered species, for which any native plant is determined to be in danger of extinction throughout all or any significant portion of its range or those listed as Endangered on the federal list. It is also a Natural Oregon Heritage Database (ONHDB) List 1 species, Threatened or Endangered throughout its range (ONHP, 1993).

The northern most populations of this species are found on Sourgrass Mountain (OA/LO), Elk Camp Meadows (managed by the Oakridge District), and Nevergo Creek (LO) which border the Lowell and Oakridge Ranger Districts. These populations were designated for monitoring (beginning spring of 1991) in the monitoring plan for the Conservation Strategy. These populations were placed in categories designated as "selected" or "non-selected" for placement of monitoring plots to determine population trends over time. The Nevergo and Elk Camp populations are designated as selected (thought to be critical to maintain viable, genetically stable populations over time throughout the species range). No human-caused impacts such as logging, trail-building, etc., will occur within these sites. The Sourgrass population (managed by the Lowell District) is designated as non-selected (deemed not to be critical for species viability). Non-selected sites are chosen where current impacts are occurring or where future ground disturbing management activities may take place.

Thompson's mistmaiden (Romazoffia thompsonii) is found in full sun in seepy rock outcrop habitats on south-facing open meadow slopes. Soil development is minimal; the substrate consists of gravel/rock, usually associated with small soil pockets and moss (Bryum miniatum) mats. This plant is dependent upon the hydraulic regime and blooms during the seasonal flow (May-June). Thompson's mistmaiden is a Central Oregon Cascades endemic, with populations documented on all 7 WNF Ranger Districts. Two main populations are located within the watershed. Thompson's mistmaiden is a USFWS Candidate 3 species (no longer being considered for listing as Threatened or Endangered), and a ONHBDB List 1 species (ONHP, 1993). Habitat where this species is found in the watershed is not generally threatened by ground disturbing activities as it is non-forested. However, one population which consists of three subpopulation sites, has two sites that are located in meadow openings directly below an active timber sale (Tiny Creek) road. These sites had not been surveyed for sensitive plants before the road was built in. These populations are currently being monitored (every two years) to document population trends over time which may potentially have been influenced by hydrological changes resulting from road construction. Additional habitat for Thompson's mistmaiden exists in the watershed that has not yet been surveyed.

Many plant species are known to be "fire-followers" as evidenced by documentation of occurrence after fire events, however, much is not yet known about the maintenance of plant/animal/fire evolutional relationships. A current sensitive plant species, the Woodland milkvetch (Astragalus Umbraticus), and a former sensitive species, branching montia (Montia diffusa), are fire followers as well as being responsive to other disturbances which create openings, such as logging. The woodland milkvetch has recently been documented in the Warner Creek Fire area in the Salt Creek Drainage (Dimling/McMahan, 1993), and is the northernmost documented range for this species. It prefers open canopies, and was noted to follow moderate intensity burn patches for the Warner populations (Dimling/McMahan, 1993). Branching montia was discovered growing very profusely after the Shady Beach fire on the Rigdon District in 1988 in plant succession ecology plots. Branching montia was also found in the Baby Rock fire area on the Oakridge District (McCabe, 1993). This pattern of occurrence influenced the downlisting of the species from sensitive to a forest Watch List species. It is likely the woodland milkvetch could follow suite and eventually be dropped off the forest sensitive list in view of recently documented occurrences. The woodland milkvetch and the branching montia could potentially occur in the watershed.

Sensitive Plants In The North Fork Middle Fork Watershed:

Species	Sitename	Subpops	Impacts
Frasera umpquaensis	Elk Camp	2	None
Romanzoffia thompsonii	Tiny Creek	4	Hydrological changes from road construction above subpopulation
Romanzoffia thompsonii	Alpine Trail	1	Trampling from trail use

The following table lists habitat in the watershed where sensitive plants may potentially be found.

Potential Habitat In The Watershed For Sensitive Plants:

Habitat	Species
Mesic meadows	Calamagrostis breweri Frasera umpquaensis Gentiana newberryi Sisyrinchium sarmentosum
Wet meadows/Bogs	Carex livida Lycopodiella inudata Ophioglossum pusillum Scheuchzeria palustris
Ponds	Utricularia minor Wolffia columbiana
Riparian	Calamagrostis breweri Huperzia occidentalis Cimicifuga elata Sisyrichium sarmentosum
Moist woods	Botrychium minganense Botrychium monatum Cimicifuga elata Huperzia occidentalis

Dry meadows/Open woods	Agoseris elata Astragalus umbraticus Frasera umpquaensis Hiercacium bolanderi
Rocky outcrops/Cliff crevices	Asplenium septentrionale Pellaea andromedaefolia Polystichum californica
Rocky slopes/Scree	Arnica viscosa Aster gormanii Romanzoffia thompsonii

(Note: under the currently proposed NFMA rule, 25 of the 28 sensitive species, including Thompson's mistmaiden would be dropped from the Willamette NF Sensitive Species list.)

RARE AND UNIQUE PLANTS

Sensitive and other rare plants, including survey and manage species, whether they are occurring at the edge of their range, disjunct, regional endemics and/or those found only in unique habitats are important contributors to the overall diversity of landscapes; some may be genetically diverse (adapted to marginal conditions), and therefore necessary genotypes to maintain the species in the advent of environmental change. It is crucial to prevent the need to list these species by accounting for them in appropriate management actions.

Additional rare plant species of concern occur in the watershed, of which some, like most sensitive plants, are found within non-forested special habitats. Others occur in forested habitats. Six species that are listed on the WNF Watch and Concern Lists are located within the watershed. These species are usually located and tracked along with sensitive plant inventories and other botanical inventories conducted in Wilderness, Special Interest Areas, and other non-timber allocation areas.

Rare And Unique Plants In The NFMF Watershed:

Watch List Species:	**Occurrence**
Erigeron cascadensis	Huckleberry Mountain (ONHP list 4)
Sidalcea cusickii	Box Canyon (ONHP list 4, OA/BR border) Major Prairie
Species Of Special Concern:	
Orobanche pinorum	coniferous woods,
Isoates sp.	Torrey Mire, Skookum Lake, Waldo Lake
Pleuricospora fimbriolata	coniferous woods, numerous sightings
Woodwardia fimbriata	road 1912

The Cascade daisy (Erigeron cascadensis) inhabits rock outcrops in high subalpine mountain peaks and is confined to bedrock and scree microsites. Cusick's checker-mallow (Sidalcea cusickii) is a bright pink checkermallow which inhabits moist meadows. The distribution of this species is patchy across the forest. The pine broomrape (O. pinorum) is found in forested habitat. This species is mycotrophic and lacks chlorophyll, receiving nutrients from the host species, most often ocean spray. The plant is found in dry coniferous woods. Plants haven't been found in clear cuts areas, where the host has been destroyed (MF WA, 1995). Populations are sprinkled as far north as the Gifford Pinchot NF in southern Washington. Quillworts (Isoates spp.) are aquatic to terrestrial spore-bearing plants, found on wet ground to wholly submerged in deep water. Fringed-pinesap (Pleuricospora fimbriolata) is another non-green species found in the duff of old-growth forests. The giant chainfern (Woodwardia fimbriata) is found along stream banks and wet places from lowlands to midmontane elevations in the understory of coniferous woods. The southern end of the Willamette NF seems to be the northernmost part of this species range.

SURVEY AND MANAGE SPECIES: FUNGI, BRYOPHYTES, LICHENS, & VASCULAR PLANTS

The ROD for the Management of Habitat for Late-Successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl (USDA and USDI, 1994) contains management direction and standards and guideline provisions for survey and manage plant and animal species generally associated with late-successional and/or riparian forests (Table C-3 list in the ROD). Ecological goals of the S&G's is to maintain late-successional and old-growth habitat and ecosystems on federal lands and to maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations. Late succesional species habitat in the watershed has declined due to extensive harvest of old-growth stands and associated road building. The remaining old-growth in the watershed is concentrated at higher elevations and, in some areas, is highly fragmented. Many survey and manage species have limited dispersal capabilities, thus in fragmented habitat areas geneflow may be restricted between populations. Single species planting after harvest in riparian forests along with adjacent upland stands has contributed to a simplification of species richness in plant communities.

Survey and manage species have not yet been systematically been inventoried in Region 6. The Regional Ecosystem Office (REO) is due to release C-3 species location information in June 1995 and survey protocols in 1996. Existing biological and ecological information is minimal for most of these species. However, it is reasonable to assume that if systematic surveys were conducted for old-growth dependent species a much larger number would be found in the watershed.

Survey and Manage measures from the ROD (1994) which apply forestwide, regardless of allocation, are as follows:

Survey strategy 1: manage known sites

- Provisions must be made for these sites for activities implemented in 1995 and later. Survey strategies 1 and 2 are the responsibility of the National Forests.

Survey strategy 2: survey prior to activities and manage sites

- For these species, activities implemented in 1999 or later must have completed surveys.

Survey strategy 3: conduct extensive surveys to find high priority sites for species management

Survey strategy 4: conduct general regional surveys

- Survey strategies 3 and 4 are more general and must be underway by 1996. These strategies are to be conducted at the regional level. Each species was rated during the analysis for the EIS and is designated certain survey strategy(ies) to follow, depending on the rarity of the species, potential threats, and numerous other factors.

Survey And Manage Species Occurring In The Watershed:

Species	Survey Strategy	Status
Vascular plants:		
Allotropa virgata	1,2	Numerous sites
Arceuthobium tsugense	1,2	
Nitrogen fixing lichens:		
Lobaria oregana	4	Districtwide
Lobaria pulmonaria	4	Districtwide
Rare nitrogen fixing lichen:		
Lobaria halli	1,3	1 site on the North Fork
Aquatic lichen:		
Hydrothyria venosa	1,2	2 sites
Semi-aquatic liverwort:		
Marsupella emarginata var. aquatica	1,2	1 documented site Waldo Lake outlet
False Truffles:		
Rhizopogon abietis	3	Waldo Wilderness
R. truncatus	3	
Rare false truffle:		
Rhizopogon evadens var. subalpinus	1,3	Waldo Wilderness
Mushrooms:		
Cantharellus cibarius	3,4	second growth stands
C.subalbidus	3,4	upper elevation areas

Discussion of groups: The following biological and ecological information regarding survey and manage species is taken from the ROD, 1994; FSEIS, USDA, USDI, 1994; FEMAT, 1993.

Fungi-

Fungi have critical roles in forested systems, contributing to nutrient cycling and changes in structural and species diversity, which in turn provides habitat for other plant and animal organisms. Mycorrhizal fungi play an important role in transferring nutrients to vascular plants. Fungal fruiting bodies, mushrooms, conks and truffles, are an important food source to small mammals; some are important for their food or medicinal value in the special forest products industry. The rare false truffle, Rhizopogon evadens var. subalpinus, is found in the Waldo Lake Wilderness in mid-upper elevations near the timberline, and is ectomycorrhizal with mountain hemlock, fir and pine species. It is disjunct from Mt. Rainier to N. California. The two False truffles, R. abietis and R. truncatus, both are found in mixed conifer stands, in relatively high elevations, in moderately dry sites, associated with Doug fir, pine, true fir, and mountain hemlock. R. abietis ranges from Oregon to California in the Cascades. R. truncatus ranges from Oregon to Washington in the Cascades. The Waldo Wilderness and Torrey-Charlton RNA areas are good examples of the fungal diversity and richness in the watershed. Chantrelles (C. cibarius and C. subalbidus are both sought after as choice edibles. Golden chantrelles are not uncommon in second growth Douglas-fir stands. A mushroom study is currently underway in the FlatWalk Young Stand Study Project on Christy Flats for C. cibarius.

Bryophytes, Hornworts, Liverworts & Mosses-

Bryophytes, the hornworts, liverworts and mosses are small, non-green, non-vascular spore-bearing plants of highly diverse habitats from deserts to coastal shores. Like many late-successional dependent species, most bryophytes do not become established until at least 100 years, becoming well developed in much older stands (400 years) and in riparian areas on hardwoods. Like lichens, they are important to nutrient cycling, accumulate air pollutants, contribute to soil structure and stability, and are food and habitat for vertebrates and invertebrates. The traditional harvest of mosses and liverworts for floral arrangement material is a serious concern for long-term sustainability of bryophyte species and their connection to ecological processes.

The rare semi-aquatic leafy liverwort, Marsupella emarginata var. aquatica, grows on rocks in the splash zone of the Waldo Lake outlet. This is the only documented occurrence in Western North America.

Lichens-

Lichens occur on many kinds of specific substrates and habitats, either growing on trees as draping or matting epiphytes, imbedded into rocks, on exposed soil in a leaf-like form, in stream splash zones, or on decaying wood. Many lichens are critical for nitrogen-fixation, some are used for air-quality biomonitors. Many lichens are important forage, nesting material and camouflage for birds and mammals, and habitat and food for invertabrates. Forest development causes a succession of lichen species, which can grow slowly over time compared to other organisms. Late-successional lichens become established with increasing successional stabilization, which may take over 200 years, some old-growth dependent species do not become established until 500 years or so, when the ecological continuity of mature tress enable them to persist. As most lichens use vegetative propagules rather than spores as a means of dispersal, their dispersal range is relatively short. They have long been harvested as SFPs for medicinal, floral, and dye-making uses.

Lobaria pulmonaria and L.. oregana are found forest-wide in old-growth stands. L. halli, a rare nitrogen-fixing lichen is documented to occur at one site along the North Fork corridor. This species is found in riparian areas and wetlands, growing most abundantly on large diameter hard woods. It ranges from north Alaska to central coastal California. Hydrothyria venosa is an aquatic lichen found on rocks in streams, where it provides habitat for aquatic invertabrates. This species does not survive desiccation and is very sensitive to water siltation and flow fluctuation; appearing more sensitive than salmon to stream sedimentation and is therefore a valuable indicator of water quality. Two sites in the North Fork corridor are listed in the database.

Vascular Plants

Two plants, Candystick (Allotropa virgata) and Hemlock dwarf mistletoe (Arceuthobium tsugense occur in the North Fork watershed. Candystick grows in deep humus, in association with coarse woody debris, in dry, well-drained soils, primarily in old-growth Douglas-fir forests in the North Fork, though this species is also found in pole and mature stands. It is a non-green mycotrophic plant that may not flower or emerge from the soil every year, instead lying dormant underground. Fire suppression, fragmentation of habitat, and reduction of large decaying logs are contributing factors to declining occurrences of this species. Candystick is slow to establish and its minute seeds have a short survival span. It does not tolerate competition well and is never abundant. Repeated thinning and shorter rotations are considered detrimental, resulting in increased competition, reduced coarse woody debris, and mechanical disturbance to the ground.

Hemlock dwarf mistletoe is parasitic on Western and Mountain hemlock. It is not uncommon in the watershed. A recommendation to the REO has been made to drop this species from the survey and manage status or change its survey strategy from 1 and 2 to 4. A decision has not yet been made as to the status of this species.

The historic representation of the pattern of the watershed landscape fire history (Chapter I, Figure 2) suggests that the western half developed into larger old-growth tracts of forest with patchy fire occurrences prior to extensive logging and fire suppression, during which time longer intervals occurred between large scale fire events. Species diversity and richness in old-growth dependent and riparian-dependent communities would have had more time to develop before increases in early seral stages were brought about by extensive timber harvesting. The eastern half of the watershed displayed a higher frequency of stand replacing fires, leaving residual patches of old-growth in a more isolated pattern, thereby leaving old-growth associated species relegated to riparian areas and refugia such as basins, valley bottoms and ridgeline breaks where a higher level of downed woody debris and snag development remained.

Marsupella emarginata var. aquatica is restricted to a wet environment in the stream channel of the Waldo Lake outlet. The current channel is not the original location of the outlet, which was modified prior to the 1930's. It is not recorded exactly where Marsupella existed prior to the stream course construction and to what extent populations reached downstream. No surveys have as yet been conducted in the watershed for this species or for other survey and manage species.

NOXIOUS WEEDS AND OTHER NON-NATIVE INVASIVE PLANT SPECIES

Non-native plant species play a significant role in influencing changes to native plant communities. Many noxious weed species and other non-native invasive plants are found in the watershed. Many of these species are firmly established and have been for some time now, and some are currently increasing in their rate of spread largely due to logging and road building practices over the long term assisting in the establishment of dispersal pathways and mechanisms.

Those non-native plant species legally designated as noxious, mean "any weed designated by the Oregon State Weed Board that is injurious to public health, agriculture, recreation, wildlife, or any public or private property" (ODA Noxious Weed Policy and Classification System, 1995). Several detrimental effects are included as the basis for criteria for rating and classifying weeds as noxious, one being "a plant species that is or has the potential of endangering native flora and fauna by its encroachment in forest and conservation areas" (ODA, 1995). Most northwest weeds are originally native to Europe or Asia and were introduced intentionally or by accident. Noxious weeds and other invasive non-natives have the potential to alter native plant communities as they are able to displace and outcompete native species. They are opportunists with broad ecological tolerances, can grow under a wide range of climatic and soil conditions, and have excellent reproductive capabilities (Taylor, 1990).

The Willamette NF initiated an Integrated Weed Management Plan Program (WNF IWMP) in 1993. The standards and guidelines in the forest plan directs us to identify and analyze noxious weed sites for the most effective control methods based on site-specific analysis of populations (USDA, 1993). The highest priority species for treatment are new invader species that are in the early stages of invasion and have not naturalized to the point that resource damage is occurring. New invaders are of biological concern in the watershed because of their potential to move from road systems in established sites into natural non-forested openings where they could outcompete natives. Control of new invaders may include hand-pulling, mechanical mowing or chemical application depending upon the characteristics of the site, closeness of water and/or human uses. Established infestations are weed species populations that have spread to the point that eradication is impossible and resource damage is unacceptable. Due to the sheer degree of infestations, control methods are generally limited to biocontrol agents, which involve the use of insects that naturally feed upon that plant and its seeds, affecting the vigor and reproduction abilities of the targeted weed.

Noxious weeds are classified on the Willamette NF as potential invader, new invader, or established species in the WNF IWMP. The following table lists the documented noxious weeds, potential noxious invaders, and several noted invasive non-natives:

Noxious Weeds, Potential Noxious Invaders and Invasive Non-natives in the NFMF Watershed:

Common Name	Scientific Name	Classification
rough pigweed	Amaranthus retroflexus	none
cheatgrass	Bromus tectorum	none
spotted knapweed	Centaurea maculosa	new, established
meadow knapweed	Centaurea pratense	new, established
ox-eye daisy	Chrysanthemum leucanthemum	none
Canada thistle	Cirsium arvense	established
bull thistle	Cirsium vulgare	established
hedgehog dogtail	Cynosurus echinatus	none
teasal	Dipsacus sylvestris	none
St. John's-wort	Hypericum perforatum	established
spotted cat's-ear	Hypochaeris radicata	none
wall lettuce	Lactuca muralis	none
nipplewort	Lapsana communis	none
everlasting peavine	Lathyrus latifolius	none
rose campion	Lychnis coronaria	none
purple loosestrife	Lythrum salicaria	potential
coast tarweed	Madia sativa	none
plantian	Plantango lanceolata	none
Giant knotweed	Polygonum sachalinense	potential
heal-all	Prunella vulgaris	none
red sorrel	Rumex acetosella	none
curly dock	Rumex crispus	none
Himalaya blackberry	Rubus discolor	none
evergreen blackberry	Rubus lacinatus	none
tansy ragwort	Scenecio jacobaea	established
spiny sowthistle	Sonchus asper	none
dandelion	Taraxacum officianle	none

Invasion and Establishment of non-native plants in the watershed are a serious threat to native plant diversity. The WNF Integrated Weed and Management Environmental Analysis lists 7 site types where potential occurs to harbor noxious weeds already established on the forest and potential invader weeds. All of these site types are found within the watershed. Site types range from bare, rocky, gravely ground such as road beds, quarries, etc., to floristically diverse areas such as meadows, sensitive plant sites, wetlands, etc., (see the EA for full descriptions).

Roadside inventories on the Oakridge Ranger District of noxious weeds were conducted by the ODA in 1988 and again in 1993. The results of these inventories have shown that some noxious weed species have increased in an alarming rate of spread. For instance, scotch broom was calculated to have infested an additional 35% sections and increased the number of roads infested to 51% (Glen Miller, personal communication).

Major forest roads and other corridors, such as right-of-way clearances serve as noxious weed dispersal pathways and establishment sites. Aufderheide Drive (FS Road 19) is a well-used travel-way by which vehicular, mechanical, and wind-born weed seed transport and spread has occurred. Timber sale units, associated roads and landing sites, trails, and other disturbed openings have seral conditions which typically support weed populations. Other spread mechanisms in the watershed include bird and mammal seed dispersal and weed seed contamination of forage and erosion control seeding mixes.

Scotch broom (Cytisus scoparius) is abundant in the lower elevation reaches of the watershed, particularly on river banks, gravel bars, roadsides, and other areas where past ground disturbance has resulted in openings. It competes with young conifers in plantations. This species is eventually outcompeted, due to lack of sunlight. A biocontrol agent, the seed feeding weevil (Apion fuscirostre), has been used on scotch broom since the 1980's and releases will be continued. Isolated targets will be emphasized in future releases. Scotch broom is a designated target or "T" weed, a selected weed that is included in an annual list of species the ODA develops to prioritize those species considered to be an economic threat to the State of Oregon and receive more intensive control treatments.

Spotted knapweed (C. maculosa) has three significant documented sites within the watershed. These are small roadside populations, targeted for proposed herbicide control in 1995. This species has also been given priority status as a target weed for established population control work and slowing population spread on the forest. It has been moving eastwards over the Cascade Crest through major travel routes and is considered a major threat to native biodiversity (USDA, 1993). Several types of biocontrol agents are being considered for use in the spotted knapweed control program.

Meadow knapweed (C. pratensis) is a hybrid between brown knapweed (C. jacea) and black knapweed (C. nigra) and is projected to become a dominant weed species in the future. It is commonly found in the Willamette Valley and is moving up in elevation (USDA, 1993). It is a garden weed and has been noted to have been dumped along with other yard debris near Hill's Creek Reservoir at the water's edge (MF WA, 1995). One significant roadside population located during the 1993 weed survey exists in the watershed.

Bull and Canada thistle (C. vulgare and C. arvense) are commonly found in timber sale clear cuts, landings, roadside sites and other areas with prior ground disturbance and open canopies in the watershed. These weeds are also found in meadow communities. These are early seral species and eventually become shaded out with canopy closure, therefore are of low risk to forested interiors. Galls formed by the fly larvae of Urophora stylata are presently being used on bull thistle to reduce flower head formation to prevent seed dispersal.

Tansy ragwort (Senecio jacobea) is widely established west of the Cascades in Oregon and is moving east over the crest of the Cascades (USDA, 1993). Tansy ragwort is well established in the watershed. Twenty-one significant roadside tansy populations were identified during the 1993 weed survey. Biocontrol agents have been in use on the district since late 1970s to control tansy densities and are still currently being released. The root-eating flea beetle (Longitarsus jacobaea), was last released on rosettes on several tansy populations within the watershed in winter 1995. Several sites, notably on FS Road 1912, contained already established flea beetle populations on plant rosettes. The Cinnabar moth (Tyria jacobaeae) was first released in Western Oregon in the 1960's to combat tansy ragwort. The moth was not tested thoroughly enough to determine plant host specificity (this testing and release of bio-control agents is accomplished by the APHIS, a section of the Federal Dept. of Agriculture) (MF WA, 1995). The Cinnabar moth was released on tansy ragwort populations to cause defoliation. Cinnabar moth defoliation damage to related native sencecio species such as arrow-leaf groundsel (S. Triangularis) has recently been of concern on the Rigdon District, where moderate impacts on the plant has been identified (MF WA, 1995). However, the cinnabar moth does not fare well during cold, wet spells, and eventually will disappear from the system (Glen Miller, pers. comm.). Informal tracking of such damage is now emphasized during shab surveys. Tansy ragwort has been included on the latest 1995 "T" list for future priority control work.

St. John's-wort (Hypericum perforatum) is an aggressive pioneer species which poses a threat to plant communities in dry and mesic meadow openings by displacing native forb and grass species via underground spread and seed set (USDA, 1993). These areas often contain natural soil disturbers such as groundhogs and mountain beavers, who provide conditions where this pioneer weed thrives. It has become a common roadside noxious weed in the watershed and is also documented to occur in Thompson's mistmaiden habitat; it is now found in most natural meadows on the district.

Weed competition is openly occurring with desirable native plant species in reforestation project areas, wildlife use areas (including small wetlands and river floodplains) and it has also been noted that some weeds are extending into natural dry/moist meadow openings and rock garden communities. In many areas, non-desirable weed species are excluding other desirable plants to the point of forming dense weed patches and thickets. The non-native invasive Himalaya and evergreen blackberries (Rubus discolor and R. lacinatus) flourish in floodplain sites and form monocultures which often extend underneath the canopy. Blackberries are currently and have long been a formidable presence in lower elevation river flats on the district and their potential rate of spread in the watershed is of concern. They are of particular concern because there are currently no biological controls available to use on blackberries and they have the potential to directly compete with the sensitive plant, tall bugbane, by occupying the same habitat (S. Santiam WA, 1995). They have not been systematically surveyed on the forest, but are now a priority for informal tracking of new infestations and rate of spread. Blackberries have also been found at higher elevations (up to 4,000 feet) at several locations in the watershed, in moist ground along roadsides and in openings. Their vigor is noticeably less higher up due to harsher site conditions. Ox-eye daisy (C. leucanthemum), another weed of concern for informal tracking, has become a common site along roads, in disturbed forest openings and meadows. It forms dense colonies and could move up into higher elevation reaches, invading meadows and reducing native plant diversity in them. This could be of special concern in wilderness and other special areas of botanical and wildlife interest. Sweet pea (Lathyrus latifolius), another potential species of concern, has been noted to occur along lower elevation roadsides on the Lowell Ranger District and the Oakridge District. It could potentially spread farther into the watershed. A noxious weed currently on the Forest's potential invader list meriting concern to watershed plant and wildlife values is purple loosestrife (Lythrum salicaria). Purple loosestrife is found in extremely wet habitats. It is currently invading the state of Oregon and is becoming established in the Willamette Valley. Wetland biodiversity in the watershed could potentially be seriously disrupted and wildlife habitat decreased by this very aggressive species. Prolific spread of purple loosestrife is accomplished by seed set (up to 3 million per plant annually) lasting several years, waterborn seed transport, and sprouting by fragmentation of plant parts and roots (ODA, 1995). No occurrence of this weed has yet been documented in the Willamette, however it is expected to eventually make its way into the forest (Glen Miller, pers. comm.). Giant knotweed (Polygonum sachalinense) is another potential invader of concern. Two populations have recently been noted on the Rigdon District (E. Everett, pers. comm.) and is found elsewhere in the Cascades. This species was introduced into the Coast Range to stabilize stream banks and is now widespread there in riparian areas (MF WA, 1995). Canary reedgrass (Phalaris arundinacea) is suspected to be present in the High Prairie area on private agricultural land. This grass is a very effective and widespread invader and has the potential to spread into upper elevations and wilderness areas. It is currently in use; propagated and dispersed for revegetation purposes (E. Everett, personal comm).

Non-native plant species have been introduced into Oregon since European settlers began bringing them into the state for uses such as ornamentals and herbal medicines. Many noxious weeds species were garden escapees or contaminants brought in inadvertently from shipping goods from overseas or overland. Scotch broom was introduced as an ornamental shrub and erosion control agent in the 1920s. The advent of logging forest land and building roads produced an abundant increase in noxious weeds and invasive non-natives since the 1930s, when many noxious weeds would have been considered newly invading species. Livestock grazing on forest land utilized on-site forage and initially did not contribute as much towards non-native invasion as did logging practices, but sheep grazing in non-forested openings likely brought in St. John's-wort and other non-native grass and forb species.

APPENDIX I:

Percent Riparian Reserve Impacted By Stand Replacement Harvest
(by planning subdrainage)

Number	Name	% Impacted by Stand Replacement Harvest	Number	Name	% Impacted by Stand Replacement Harvest
171	Coffee	64	17U	Captain	34
172	Tenth	11	17V	Major Parker	47
173	Eight	43	17W	Roosevelt	43
174	Huckleberry	42	17X	Devils Canyon	11
175	Fifth	20	17Y	Hemlock	12
176	Third	23	17Z	Whiterock Shale	43
177	First	21	24A	Glade	23
178	High Prairie	16	24B	Augusta	8
179	Mossy - Grassy	55	24C	Tiny	2
17A	Short - Hemlock	24	24D	Box Canyon	1
17B	Dartmouth	27	24E	Outer Bend	3
17C	Leapfrog	21	24F	Skookum	0
17D	High	28	24G	Otter	0
17E	Hammer	46	24H	Erma Bell	0
17F	McKinley	38	24I	Pothole	0
17G	Chalk	34	24J	Harvey	0
17H	Evangeline	46	24K	Torrey	0
17I	Billy	48	24L	Waldo	0
17J	Nehi	51	24M	Eddeeleo	0
17K	Sardine	56	24N	Moolack Lake	1
17L	Christy Head	28	24Q		0
17M	Lowell	49	24R		0
17N	Lowell Head	37	24S		19
17P	Christy South	49	24T		12
17Q	Flats	4	24U		45
17R	Buffalo	17	24V		26
17S	Major Prairie	63	24W		12
17T	Brock	33			

APPENDIX J:

Culvert Hydraulic Analysis

Walk Thin Timber Sale Culvert Assessment

Road				Culvert	Flow Capacity				Pipe	Fill	Inlet		Outlet			Q 100/10	
No.	MP	Stream Name	Diam	Length	Slp%	Pipe	Fill	Q100	%Q100	%Q100	Plug%	Dent%	Plug%	Dent%	Drop	D	V
1926	1.99		5	46	12						10	5	0	0	8		
1926-636	0.41		2	34.5	5						5	0	0	0	0		

North Fork Timber Sales Culvert Assessment

Road				Culvert	Flow Capacity				Pipe	Fill	Inlet		Outlet			Q 100/10	
No.	MP	Stream Name	Diam	Length	Slp%	Pipe	Fill	Q100	%Q100	%Q100	Plug%	Dent%	Plug%	Dent%	Drop	D	V
19	3.45		2	49	7	14	28	39	36	72	25	2	0	0	6	0.5	7.1
19	4.95	First	8x5.5	30	2	322	406	460	70	88	0	0	0	0	2	0.7	8.1
19	6		3	48	5	33	66	41	80	161.0	5	0	50	0	1.5	0.4	6.3
19	6.15		4	57	8	68	108	104	65	104	0	0	0	0	1	0.6	9.4
19	6.4	Huckleberry	7	71	10	294	919	1318	56	70	0	0	0	0	6	1.62	18
			8.5	71	6	447					5	0	0	0	7	1.8	15.3
19	7.82		2.5	61	8	21	47	41	51	115	25	20	0	0	3	0.4	7.5
19	7.9	Eighth	3	46	9	35	92	354	10	26	15	10	0	0	2.5	1.2	13.4
19	10.1		3	60	2	31	70	57	54	123	40	0	10	0	0	0.7	4.8
19	12.4	Tumble	8.5	47	6	414	563	318	130	177.0	0	0	0	0	1		
19	13.64	Coffee	5	57	6	125	246	125	100	197	0	0	0	0	5	0.6	8.8
19	13.92	Sidewalk	5	81	2	119	308	149	80	207	0	0	0	0	2	0.9	6
19	14.4	Whiterock	5	87	9	122	219	153	80	143	0	0	0	1	2	0.6	10.7
19	14.55	Plateau/Shale	4	87	4	68	178	170	40	105	0	0	0	1	6	0.9	8.3
19	16.9	Cedar	6	74	6	180	461	326	55	141	0	0	0	1	4	0.9	11.3
19	17.3	Devils Canyon	10	113	4	720	1093	522	138	209	10	0	0	0	5	1.1	10.5
19	18.2	Roosevelt	6.5	60	2	215	722	341	63	212	5	0	10	0	0	1.3	7.4
19	18.81	Steer	4	53	7	70	80	67	104	119	2	0	0	0	6	0.5	7.9
19	19.1	Silver	4	54	14	75	129	136	55	95	5	0	20	0	0	0.6	12.5
19	19.3	Major	4	57.5	2	74	104	147	50	71	0	0	0	0	0.5	0.9	6.6
19	19.85	Parker	9.8x7.5	125	6	470	732	410	115	179	0	0	0	0	10		
19	20.7		5	70	2	130	190	134	97	142	0	0	0	0	1.5	0.8	6
19	21.01		4	73	12	72	152	144	50	106	0	0	0	0	1.5	0.6	11.9

Riparian and Special Habitat Species Guilds -- preliminary guilding

Common Name	Guild
American coot	LKRVA
American widgeon	LKRVA
California gull	LKRVA
Caspian tern	LKRVA
Glaucous-winged gull	LKRVA
Greater scaup	LKRVA
Greater white-fronted goose	LKRVA
Pacific loon (Arctic)	LKRVA
blue-winged teal	LKRVA
bonaparte's gull	LKRVA
canvasback	LKRVA
cinnamon teal	LKRVA
common loon	LKRVA
dunlin	LKRVA
eared grebe	LKRVA
Eurasian widgeon	LKRVA
gadwall	LKRVA
green-winged teal	LKRVA
horned grebe	LKRVA
leach's storm petrel	LKRVA
lesser scaup	LKRVA
northern pintail	LKRVA
northern shoveler	LKRVA
oldsqaw	LKRVA
red phalarope	LKRVA
red-throated loon	LKRVA
redhead	LKRVA
ring-billed gull	LKRVA
ruddy duck	LKRVA
snow goose	LKRVA
surf scoter	LKRVA
trumpeter swan	LKRVA
tundra (whistling) swan	LKRVA
western grebe	LKRVA
white-winged scoter	LKRVA
Canada goose	LKRVARE
killdeer	LKRVARE
mallard	LKRVARE
water vole	LKRVARE
western pond turtle	LKRVARE
Dunn's Salamander	LKRVARG
bald eagle	LKRVARG
beaver	LKRVARG
bullfrog	LKRVARG
common egret	LKRVARG
double-crested cormorant	LKRVARG
great blue heron	LKRVARG
green-backed heron	LKRVARG
mink	LKRVARG
muskrat	LKRVARG
nutria	LKRVARG
osprey	LKRVARG
pied-billed grebe	LKRVARG
ring-necked duck	LKRVARG
river otter	LKRVARG
white-faced ibis	LKRVARG
American dipper	LKRVARML
Barrow 's goldeneye	LKRVARML

Common Name	Guild
Cascade torrent salamander	LKRVARML
Pacific giant salamander	LKRVARML
Pacific water shrew	LKRVARML
belted kingfisher	LKRVARML
bufflehead	LKRVARML
common goldeneye	LKRVARML
common merganser	LKRVARML
harlequin duck	LKRVARML
hooded merganser	LKRVARML
tailed frog	LKRVARML
water shrew	LKRVARML
wood duck	LKRVARML
Anna's hummingbird	LKRVRE
common yellowthroat	LKRVRE
marsh wren	LKRVRE
purple martin	LKRVRE
yellow-breasted chat	LKRVRE
American redstart	LKRVRG
bank swallow	LKRVRG
northern rough-winged swallow	LKRVRG
warbling vireo	LKRVRG
downy woodpecker	LKRVRML
red-eyed vireo	LKRVRML
white-footed vole	LKRVRML
American bittern	SPCL
Long-billed dowitcher	SPCL
Solitary sandpiper	SPCL
Sora	SPCL
Townsend's big-eared bat	SPCL
Virginia rail	SPCL
acorn woodpecker	SPCL
barn owl	SPCL
barn swallow	SPCL
black swift	SPCL
bushy-tailed woodrat	SPCL
cliff swallow	SPCL
common snipe	SPCL
greater yellowlegs	SPCL
house mouse	SPCL
least sandpiper	SPCL
lesser yellowlegs	SPCL
northern harrier	SPCL
northern waterthrush	SPCL
pectoral sandpiper	SPCL
peregrine falcon	SPCL
pika	SPCL
prairie falcon	SPCL
red-winged blackbird	SPCL
rock dove	SPCL
rock wren	SPCL
sandhill crane	SPCL
semipalmated plover	SPCL
short-horned lizard	SPCL
spotted frog	SPCL
spotted sandpiper	SPCL
white-headed woodpecker	SPCL
yellow-bellied marmot	SPCL

Generalist Habitat Species Guilds -- preliminary guilding

Common Name	Guild	Common Name	Guild
American crow	TLGG	clouded salamander	TLGG
black bear	TLGG	coast mole	TLGG
bobcat	TLGG	common garter snake	TLGG
common raven	TLGG	dark-eyed junco	TLGG
coyote	TLGG	deer mouse	TLGG
gray fox	TLGG	dusky shrew	TLGG
gray wolf	TLGG	ermine	TLGG
lynx	TLGG	evening grosbeak	TLGG
mountain lion	TLGG	golden-crowned kinglet	TLGG
wolverine	TLGG	golden-mantled ground squirrel	TLGG
Bohemian waxwing	TLGG	hairy woodpecker	TLGG
Cooper's hawk	TLGG	hermit thrush	TLGG
Virginia opossum	TLGG	house finch	TLGG
Yuma myotis	TLGG	house sparrow	TLGG
common nighthawk	TLGG	long-toed salamander	TLGG
gray flycatcher	TLGG	mountain beaver	TLGG
gray jay	TLGG	mountain chickadee	TLGG
hoary bat	TLGG	mourning dove	TLGG
long eared owl	TLGG	northern alligator lizard	TLGG
long-eared myotis	TLGG	northern oriole	TLGG
long-legged myotis	TLGG	northern pygmy-owl	TLGG
long-tailed weasel	TLGG	northwestern salamander	TLGG
mule deer and black-tailed deer	TLGG	Oregon meadow vole	TLGG
northern flicker	TLGG	pacific jumping mouse	TLGG
northern saw-whet owl	TLGG	pine grosbeak	TLGG
porcupine	TLGG	pine siskin	TLGG
sharp-shinned hawk	TLGG	purple finch	TLGG
silver-haired bat	TLGG	raccoon	TLGG
spotted skunk	TLGG	red crossbill	TLGG
striped skunk	TLGG	red-breasted sapsucker	TLGG
western rattlesnake	TLGG	red-legged frog	TLGG
western small-footed myotis	TLGG	red-napped sapsucker	TLGG
wild turkey	TLGG	ring-tailed cat	TLGG
American robin	TLGG	ringneck snake	TLGG
Cascade frog	TLGG	roughskin newt	TLGG
Douglas' squirrel	TLGG	rubber boa	TLGG
Ensatina	TLGG	ruby-crowned kinglet	TLGG
Hammond's flycatcher	TLGG	ruffed grouse	TLGG
Hutton's vireo	TLGG	rufous hummingbird	TLGG
Norway rat	TLGG	rufous-sided towhee	TLGG
Pacific tree frog	TLGG	sharptail snake	TLGG
Steller's jay	TLGG	snowshoe hare	TLGG
Swainson's thrush	TLGG	solitary vireo	TLGG
Townsend's chipmunk	TLGG	song sparrow	TLGG
Townsend's solitaire	TLGG	southern alligator lizard	TLGG
Vaux's swift	TLGG	tree swallow	TLGG
Wilson's warbler	TLGG	vagrant shrew	TLGG
band-tailed pigeon	TLGG	violet-green swallow	TLGG
black-capped chickadee	TLGG	western gray squirrel	TLGG
black-chinned hummingbird	TLGG	western redback salamander western	TLGG
black-headed grosbeak	TLGG	screech-owl	TLGG
black-throated gray warbler	TLGG	western tanager	TLGG
blue grouse	TLGG	western toad	TLGG
brush rabbit	TLGG	western wood-pewee	TLGG
cedar waxwing	TLGG	winter wren	TLGG
chestnut-backed chickadee	TLGG	yellow warbler	TLGG
chipping sparrow	TLGG	yellow-pine chipmunk	TLGG
Clark's nutcracker	TLGG	yellow-rumped warbler	TLGG

Contrast Habitat Species Guilds -- preliminary guilding

Common Name	Guild	Common Name	Guild
boreal owl	TLC	little brown myotis	TMC
elk	TLC	Cassin's finch	TSC
golden eagle	TLC	Lewis' woodpecker	TSC
great gray owl	TLC	Nashville warbler	TSC
great horned owl	TLC	ash-throated flycatcher	TSC
red-tailed hawk	TLC	brown-headed cowbird	TSC
turkey vulture	TLC	dusky flycatcher	TSC
American kestrel	TMC	flammulated owl	TSC
California myotis	TMC	heather vole	TSC
European starling	TMC	olive-sided flycatcher	TSC
big brown bat	TMC		

KEY TO WILDLIFE GUILDS OF THE WILLAMETTE NATIONAL FOREST

LKRVA = Lake or river, using the aquatic portion only.
LKRVARE = Lake or river, using the aquatic portion and terrestrial riparian vegetation in the early seral stage.
LKRVARG = Lake or river, using the aquatic portion and terrestrial riparian vegetation regardless of seral stage (generalist).
LKRVARML = Lake or river, using the aquatic portion and terrestrial riparian vegetation in the mid and late seral stages.
KRVRE = Lake or river, using the terrestrial vegetation only in an early seral condition.
LKRVRG = Lake or river, using the terrestrial vegetation only regardless of seral stage (generalists).
LKRVRML = Lake or river, using the terrestrial vegetation only in mid and late seral stages.
SPCL = Associated with a special habitat, as listed.
TLC = Terrestrial, large home range, contrast species.
TLGG = Terrestrial, large home range, generalist species.
TLME = Terrestrial, large home range, mosaic, early seral stage users.
TLML = Terrestrial, large home range, mosaic, late seral stage users.
TMC = Terrestrial, medium home range, contrast species.
TMGG = Terrestrial, medium home range, generalist species.
TMME = Terrestrial, medium home range, mosaic early seral stage users.
TMML = Terrestrial, medium home range, mosaic late serral stage users.
TMPE = Terrestrial, medium home range, patch species, early seral.
TSC = Terrestrial, small home range, contrast species.
TSGE = Terrestrial, small home range, generalist early seral.
TSGEM = Terrestrial, small home range, generalist early/mid seral.
TSGG = Terrestrial, small home range, generalist.
TSGML = Terrestrial, small home range, generalist mid/late seral.
TSME = Terrestrial, small home range, mosaic early.
TSPE = Terrestrial, small home range, patch species, early seral.
TSPL = Terrestrial, small home range, patch species, late seral.

Figure: 1a

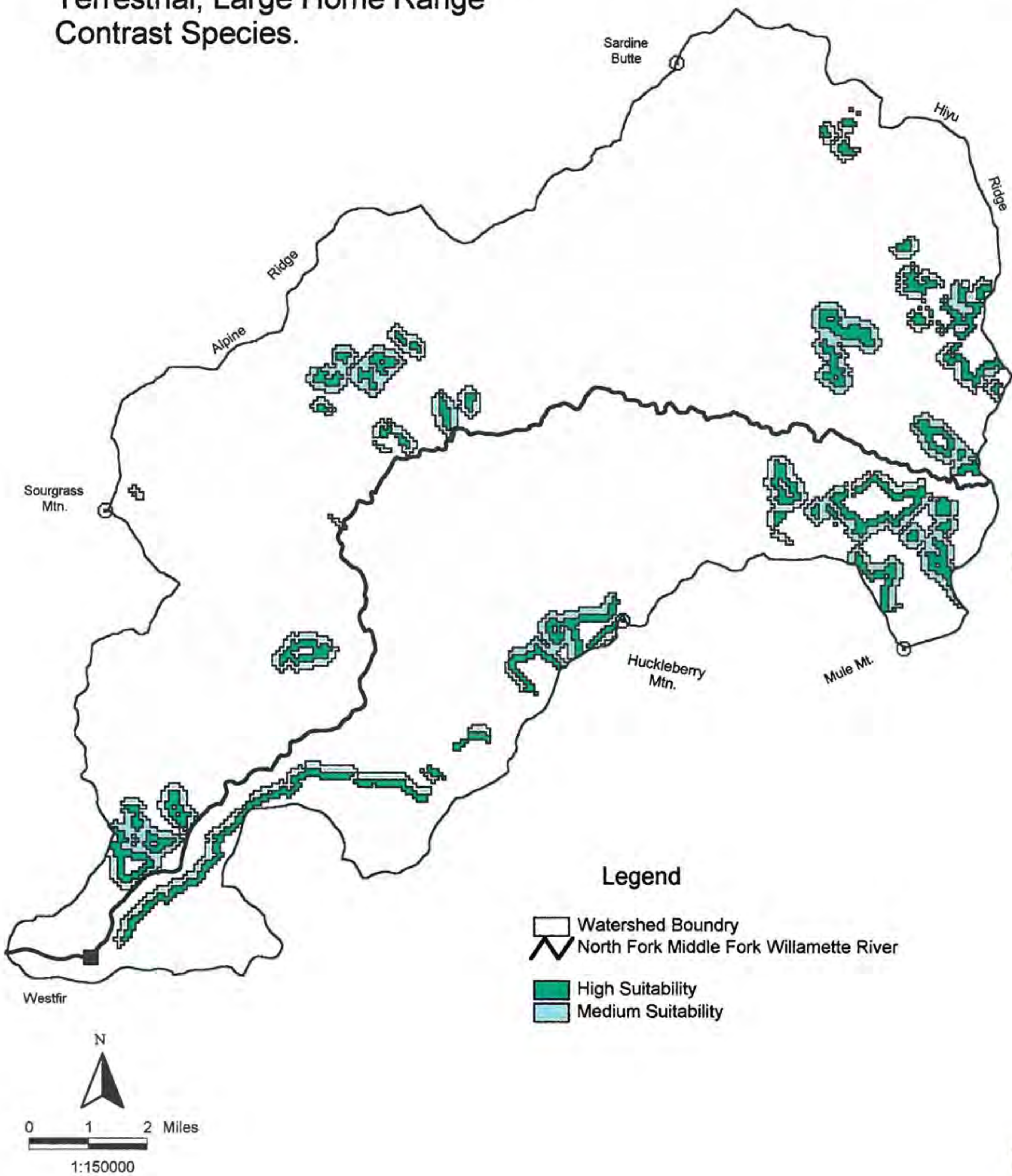
Historic

Terrestrial, Large Home Range

Contrast Species.

Lower North Fork Middle Fork

Willamette River Watershed



Road				Culvert	Flow Capacity				Pipe	Fill	Inlet		Outlet			Q 100/10	
No.	MP	Stream Name	Diam	Length	Slp%	Pipe	Fill	Q100	%Q100	%Q100	Plug%	Dent%	Plug%	Dent%	Drop	D	V
19	21.32		4	42	2	62	67	56	111	120	10	1	0	0	0	0.6	4.8
19	22.23	Brock	11	87	3	875	1197	372	235	322	2	0	5	0	0	1.1	7.5
19	22.52		6	59	3	185	301	137	135	220	0	2	5	0	0	0.7	6.9
19	23.39	Glade	7	72	9	290	313	261	111	120	0	0	5	0	0	0.7	13.1
19	24.5	Little	8	76	3	380	466	89	427	524	15	0	0	0	0	0.4	4.6
19	24.79		6	70	4	198	316	330	60	96	5	0	0	0	0.3	1.1	9.6
19	27.68	Minute	8	62	6	300	363	137	219	265	5	0	10	0	0	0.8	10.4
19	28.75		2.5	51	2	27	48	108	25	44	0	0	0	1	0	1	5.8
19	28.9	Box Canyon	6.5	66	1	209	294	348	60	84	0	0	1	0	0	1.5	6

APPENDIX K:

Riparian Thinning Analysis

On December 14, 1994 Al Johnson (hydrologist), Eric Ornberg (planner/silviculturist), Dede Steele (wildlife biologist), Kim MacMahan (botanist), and Tim Bailey (planner/silviculturist) met to develop prescriptions for the young managed stand thinning, typically that proposed in stands 35 to 45 years old created by past harvest.

We were especially interested in proposed thinning as most young managed stands contain riparian reserves as prescribed by the Northwest Forest Plan. We wanted to come to a common understanding as to whether it was appropriate and desirable to thin within riparian reserves, and if so, whether thinning prescriptions should be different between riparian zones and adjacent matrix land.

Based upon typical age, densities, and general condition of these young stands; our desire to minimize the number of harvest entries to minimize the amount of soil and residual tree disturbance, and the common goal of all these thinnings to increase within-stand structural diversity, we determined that most thinning prescriptions within matrix lands should harvest roughly 50 percent of the existing stems. We also agreed that there should be no thinning within 50 feet of channel edges to provide for a constant, high level of fine organic material input, to maintain existing rooting strength, and to avoid the possibility of channel edge disturbance. We also recognized that often times the conifers immediately adjacent to the stream channels are not particularly dense due to the greater diversity of tree and shrub species in riparian environments, so there is a lesser need to thin to promote diversity or to generate larger conifer stems.

Our discussion centered upon whether and how the riparian reserves between 50 and 200 feet from the stream (the site potential tree heights for most of these proposed units are about 200 feet) should be thinned. Recognizing that we want to assure (for both aquatic and terrestrial habitat long-term objectives) these stand will in the future contain large-diameter dominant trees, we believe thinning at some level is necessary within the riparian reserves. To avoid creating an overly-large change in microclimate however, we initially suggested that riparian reserve thinning between 50 and 200 feet from stream channels be less intensive than what would be prescribed for adjacent matrix lands. We identified the following advantages to thinning the riparian reserves (again between 50 and 200 feet from the stream channels) to a density about one third less than current conditions, a spacing between dominant conifers of approximately 17 feet, depending upon the stand in question:

- It would better buffer microclimate changes (temperature of air, soil, water; humidity; solar radiation; etc.) in the unthinned area immediately adjacent to the channels

- The amount of crown damage from a heavy thinning could add to the above microclimate changes, provide a more open environment, and result in longer periods of crown closure recovery

- There would be less potential for damage to understory layers near stream channels

- It might provide better currently available dispersal habitat and more immediately effective dispersal corridors

- It would provide for greater overall within-stand structural and species diversity

- A 30 percent harvest prescription would leave more options for wildlife tree/large woody debris management, i.e. more trees would be available for falling or girdling without additional microclimate impacts or without causing the stands to become understocked;

- It would provide a buffer for potential losses from windthrow and snow breakage

- It would mean less trees to mark (easier implementation)

We identified the following disadvantages of thinning the riparian reserves (again between 50 and 200 feet from the stream channels) to a lesser spacing than adjacent Matrix Lands:

- There would be a reduced rate of diameter growth in the riparian reserve as compared to adjacent Matrix lands. This could result in a stand within the riparian reserve which has noticeably smaller dominant tree diameters as compared to adjacent Matrix areas in the future (50 to 100 years);

- It would be a more complex prescription to be implement because there would have to be more measuring and tree marking personnel would have to keep in mind two separate prescriptions

Recommendations-

The above stated advantages of thinning riparian reserves to a lesser spacing are certainly more numerous than the disadvantages but it should be noted that the disadvantage of creating riparian stands with diameters smaller than the stands as a whole as the result of a different thinning prescription is of some concern. It should also be noted that many of the advantages are only short-term advantages and the disadvantage of slower relative diameter growth is long-term. Potential micro-climate changes resulting from a heavier thinning might not last much longer than a decade, possibly less. That not withstanding, we have still opted to take a conservative approach in the short-term effects and have recommended in the following discussion that perennial stream riparian reserves be thinned to leave a somewhat greater leave tree density to avoid potential excessive changes in micro-climate and general stand disturbance.

It should be kept in mind that growth rates for stands thinned as we suggest should be monitored and modeled, including a projection of diameter growth for the thinning prescriptions proposed. If we begin to see a trend indicating that riparian stands in decades hence may be of considerably smaller diameter than adjacent upland stands such that we may not be able to produce stems of sufficient size to fully meet aquatic conservation strategy objectives, we should then reconsider this conservative approach to thinning within riparian reserves.

With these qualifications, our recommendations for thinning in riparian reserves for the Heart and Finberry planning areas are as follows:

- No thinning should occur within 50 feet of any class of stream channel

- The portion of the riparian reserve from 50 to 200 feet from the channel edge should be thinned to a lesser degree than adjacent matrix lands (in these sale areas, a harvest of about 30 percent of the stand) in class II and III riparian reserves and adjacent to special wildlife habitats and wetlands greater than one acre

- The portion of class IV riparian reserves from 50 to 200 feet from the channel should be thinned with the same prescription used on adjacent Matrix lands, in these cases about half of the stems in the stands. Where site specific conditions indicate a need for greater protection of riparian resources, a wider no cut area or a 30 percent harvest should be implemented

- The no harvest areas immediately adjacent to channels could be narrower than 50 feet if site specific conditions indicate a need (i.e. very dense, stagnated stands), to be no narrower than 20 feet. This situation is not expected to occur very often

- Precommercial thinning could occur even closer to stream channels than above if the stand is dense. Serious consideration should be given to a fairly wide precommercial spacing in riparian zones to establish fast diameter growth early on in the hope of avoiding the need to commercially thin later when a change in microclimate and damage to understory vegetation could be of concern

- Wetlands and special habitat less than one acre should be protected with a 50 foot wide no-harvest buffer and thinning the same as prescribed for adjacent matrix lands in the remainder of the riparian reserve. In special situations where there is a need identified, this no-harvest buffer could be greater or a two-level thinning prescription could be implemented. In any case, such areas should be protected to the extent provided for in the Forest Plan.

How Thinning In Riparian Reserves Relates To The Northwest Forest Plan Aquatic Conservation Strategy Objectives (April 4, 1995)

This discussion focuses on proposed thinning of young managed stands (from 25 to 50 years of age) created by past clearcut harvest. This past harvest did not treat riparian zones differently than upslope areas and the stands are more or less homogenous across the slope. As of this writing most of the stands in this age range contain moderate to large amounts of large woody debris in and near stream channels as well as in upland areas but they contain essentially no large residual trees or snags. Most of these young stands were planted almost exclusively with Douglas-fir, though other species have naturally established to a greater or lesser extent. These stands were densely planted and those proposed for thinning are quite dense, often to the extent that tree mortality is currently occurring or soon will and understory ground vegetation is sparse to non-existent. Thinning is proposed in the riparian portion of these managed stands generally to create a more diverse stand and to assure that riparian stands have the same stem size distribution and understory composition as adjacent thinned upland stands. How thinning specifically affects the nine Aquatic Conservation Strategy Objectives presented on page B-11 of the Northwest Forest Plan follows below:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to assure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

Thinning will help to better achieve this objective. Thinning is proposed in these young stands to provide for a more diverse riparian and terrestrial stand by opening up the canopy somewhat such that shade tolerant conifers and ground vegetation can become established or to provide for the more vigorous growth of that which already exists. Thinning will also provide for greater long-term structural diversity by generating larger stem diameters, overall greater variation in stem sizes, a structurally more complex dominant tree crown (deeper, with thicker branches) and future sources of appropriately large snags and down woody material. If these dense, young stands are not thinned there will be, to a large extent, a detrimental impact on aquatic and terrestrial populations and communities in the long-run as these stands may take a very long time to generate large stem calipers and late-successional habitat conditions in general if they remain at their current densities.

2. 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.

Thinning will not affect the connectivity these recovering riparian stands now provide. While there may be some short-term negative effects in terms of micro-climate changes by reducing the current crown coverage, or in terms of branches and trees tops creating barriers to animal movement, there is an overall benefit in creating more structurally complex habitat for animals to travel through in the future.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks and bottom configurations.
Yarding systems and harvest prescriptions would be designed to maintain channel stability in all cases including intermittent stream channels. Riparian areas within 10 to 50 feet of stream channels would generally not be thinned. Trees to be removed will not be transported across stream channels unless an analysis shows that additional road construction needed to avoid yarding across streams would be more harmful than a narrow skyline corridor through the riparian area. Skyline yarding corridors across stream channels would minimized, however where analysis determined that yarding across a stream channel could be accomplished while protecting streambanks and channels, stream crossing corridors would be allowed. Logs would be fully suspended above intermittent and perennial stream channels unless analysis determined yarding could be accomplished while maintaining objectives for protection streambanks and channels.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.
Thinning would have a neutral effect on water quality in the short run. In the long run it may have a slightly beneficial effect as thinning will speed up the creation of large stems, some of which will eventually fall into the channels to provide for more stable channels. Retention of all trees within 50 feet of stream channels will provide for shade to maintain cool stream temperatures.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate and character of sediment input, storage and transport.
See the above discussion; thinning will have neutral effect on sediment regimes as long as road construction effects are balanced with the desire to minimize yarding across stream channels. Thinning would enhance development of LWD which when incorporated into stream channels has beneficial effects on storage and routing of sediment. No harvest areas adjacent to stream channels should mitigate the potential for stream bank erosion.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.
Thinning will have a neutral effect on in-stream flows. Though thinning would reduce the amount of evapotranspiration in riparian zones and adjacent uplands, this effect would be very temporary; there would not be long-term change in the amount of leaf area supported by these sites. To a large extent thinning can be thought of as an activity that re-structures, rather than reduces, the vegetation occurring on a site. Thinning would also have a long-term positive effect on sediment, nutrient, and wood routing as discussed in objectives 4. and 5. above.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Thinning will have a neutral effect on the timing and variability of floodplain inundation and wetland water table levels, similar to the effects on in-stream flows as discussed above.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration to supply amount and distributions of coarse woody debris sufficient to sustain physical complexity and stability.
Thinning is proposed in riparian stands primarily to better accomplish this strategic objective. Thinning will modify the species composition of these stands to more closely approximate the composition of stands occurring in these riparian areas prior to the regeneration harvest. Reducing the density of these stands will provide for growth of large tree boles which will ultimately have a number of positive effects on channel stability and complexity, as well as general stand structural diversity. Thinning will provide for the establishment and growth of understory vegetation which will provide for greater structural a diversity and for better thermal regulation and nutrient filtering. Thinning will have a neutral effect on surface and bank erosion. Thinning, through the eventual generation of larger in-channel woody debris, could influence future channel migration but the introduction of larger woody debris could also enhance channel stability.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian species.
The young, previously managed stands proposed for thinning do not currently comprise late-successional habitat. One of the primary objectives of this proposed thinning is to make these dense, young stands more diverse from a structural and species composition perspective. Thinning will ultimately produce a more structurally diverse stand.

APPENDIX L:

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APPENDIX M:

Glossary

Many of the definitions in this glossary are referenced to the following sources. The sources are identified by a number in parentheses following the definition. This number corresponds to the list below. Some other terms will be referenced to Forest Service Manuals (FSM), Forest Service Handbooks (FSH), or other sources which are too numerous to list. Finally, many other definitions are not referenced, but are those in general use on the Forest.

SOURCE LIST

1) CFR 219 National Forest Management Act Regulations.
2) Regional Guide for the Pacific Northwest Region, 1984.
3) SAF Dictionary of Forestry Terms, 1971.
4) The Random House College Dictionary, Revised Edition, 1975.
5) Webster's New International Dictionary, 1957.
6) Wildland Planning Glossary, 1976.
7) Webster's Third New International Dictionary, 1981.
8) Wildlife Habitats in Managed Forests, The Blue Mountains of Oregon and Washington, 1979.
9) A Glossary of Terms Used in Range Management.
10) Forest Service Manual or Forest Service Handbook.

- A -

Age class - An interval, usually 10 to 20 years, into which the age ranges of vegetation are divided for classification or use. (3)

Aggregate Recovery Percent (ARP) - Measure of the vegetative condition related to its ability to intercept rain, snow, and wind and its ability to modify snow accumulation and melting.

Airshed - A geographic area that, because of topography, meteorology, and climate, shares the same air. (2)

Alluvium, Alluvial - Sediments deposited by water.

Anadromous Fish - Those species of fish that mature in the sea and migrate into streams to spawn. Salmon, steelhead, and searun cutthroat trout are examples.

Andesite - A moderately hard light colored rock produced by volcanic eruption.

Appropriated Funds - Moneys authorized by an act of Congress which permit Federal agencies to incur obligations and to make payments out of the US Treasury for specified purposes.

Aquifer - Underground strata containing water.

Aquatic ecosystems - Stream channels, lakes, marshes or ponds, and the plant and animal communities they support.

Artifact - An object made or modified by humans. (4)

Available forest land - Land which has not been legislatively or administratively withdrawn by the Secretary of Agriculture or Forest Service Chief from timber production.

- B -

Background - In visual management terminology, refers to the visible terrain beyond the foreground and middleground where individual trees are not visible, but are blended into the total fabric of the stand. Also a portion of a view beyond three to five miles from the observer, and as far as the eye can detect objects. (6)

Bald Eagle Management Area (BEMA) - An area allocated by the Willamete National Forest Plan to be managed for the benefit of American Bald Eagles.

Basaltic - A hard generally dark and dense rock type produced by volcanic eruption.

Base Flow - The portion of a stream or river flow attributable to ground water interception, usually a very constant amount.

Bedload - The coarse sediment moved by a stream or river which moves along the bed of the stream.

Beneficial uses - In water use law the reasonable use of water for a purpose consistent with the laws and best interest of the people and the state.

Best Management Practices - A practice or combination of practices that is determined by a State (or designated areawide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation, to be the most effective, practicable (including technological, economic,
and institutional considerations) means of preventing or reducing the amount of pollution generated by
nonpoint sources to a level compatible with water quality goals (Federal Register, Volume 40, No. 230 dated 11/28/75).

Big game - Large mammals hunted for sport. On the National Forest these include animals such as deer, elk, antelope, and bear. (8)

Big Game Emphasis Area (BGEA) - An area of land designated by the Willamette National Forest Plan with prescriptions for specific habitat qualities for deer and elk.

Big game summer range - A range, usually at higher elevation, used by deer and elk during the summer. Summer ranges are usually much more extensive than winter ranges. (8)

Big game winter range - A range, usually at lower elevation, used by migratory deer and elk during the winter months; usually more clearly defined and smaller than summer ranges. (8)

Biological diversity - Terms used in the Forest Plan to provide goals and direction for evaluating the significance of old growth stands, minimizing fragmentation of existing old growth forests, and maintaining many of the structural components of unmanaged stands in managed stands.

Board foot (BF) - The amount of wood equivalent to a piece of wood one foot by one foot by one inch thick. (3)

Broadcast Burn - Allowing a prescribed fire to burn over a designated area within well-defined boundaries for reduction of fuel hazard or as a silvicultural treatment, or both.

Browse - Twigs, leaves, and young shoots of trees and shrubs on which animals feed; in particular, those shrubs which are used by big game animals for food. (6)

Browse Enhancement - The act of cutting down brush or hardwood vegetation when it is too tall, decadent, or low in nutritional value to increase its future value to browsing animals, usually big game. This cutback allows the vegetation to resprout and become more available and or higher quality.

- C -

Canopy - The more-or-less continuous cover of branches and foliage formed collectively by the crown of adjacent trees and other woody growth. (3)

Cavity - The hollow excavated in trees by birds or other natural phenomena; used for roosting and reproduction by many birds and mammals. (2)

Char - A group of fish in the Salmonid family - in this watershed, brook trout and bulltrout.

Clearcutting - The cutting method that describes the silviculture system in which the old crop is cleared over a considerable area at one time. Regeneration then occurs from (a) natural seeding from adjacent stands, (b) seed contained in the slash or logging debris, (c) advance growth, or (d) planting or direct seeding. An even-aged forest usually results. (3)

Climax - The culminating stage in plant succession for a given site where the vegetation has reached a highly stable condition. (6)

Collurturn - Material (soil and rock) that has been deposited through gravity (as opposed to water).

Commercial Forest Land - Land that is producing, or is capable of producing, crops of industrial wood and (1) has not been withdrawn by Congress, the Secretary of Agriculture, or the Chief of the Forest Service; (2) land where existing technology and knowledge is available to ensure timber production
without irreversible damage to soil productivity or watershed conditions; and (3) land where existing technology and knowledge, as reflected in current research and experience, provides reasonable assurance that adequate restocking can be obtained within 5 years after final harvesting. See also "Tentatively Suitable Forest Land."

Commercial thinning - Any type of tree thinning that produces merchantable material at least equal in value to the direct costs of harvesting. (3)

Compaction - The packing together of soil particles by forces exerted at the soil surface, resulting in increased soil density.

Conk - The woody fruiting body of fungal species, that usually grow on dead or live tree stems.

Connectivity - A measure of the extent to which conditions among late-successional and/or old growth (LS/OG) areas provide habitat for breeding, feeding, dispersal, and movement of LS/OG associated wildlife and fish species.

Corridor - A linear strip of land identified for the present or future location of transportation or utility rights-of-way within its boundaries. (1)

Course sediment - Sands, gravels, cobbles, boulders.

Cultural resource - The remains of sites, structures, or objects used by humans in the past--historic or prehistoric. (2)

Cumulative effects or impacts - Cumulative effect or impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7 - these regulations use effects and impacts synonymously.)

- D -

Debris Torrent - A large debris slide that is charged with water and confined to a steep stream channel. Debris torrents may travel several thousand feet, but are generally shallow as opposed to deep-seated mass movement.

Deep-seated Mass Movement - The downhill movement of deep soils and weathered bedrock, usually under saturated conditions. Such events usually do not move as far as a debris torrents do.

Designated Area (Air Quality) - Those areas delineated in the Oregon and Washington Smoke Management Plans as principal population centers of air quality concern.

Developed recreation - Recreation that requires facilities that, in turn, result in concentrated use of an area. Examples of developed recreation areas are campgrounds and ski areas; facilities in these areas might include roads, parking lots, picnic tables, toilets, drinking water, ski lifts, and buildings. (2)

Diameter at breast height (d.b.h.) - The diameter of a tree measured 4 feet 6 inches above the ground. (6)

Dispersed recreation - A general term referring to recreation use outside developed recreation sites; this includes activities such as scenic driving, hiking, backpacking, hunting, fishing, snowmobiling, horseback riding, cross-country skiing, and recreation in primitive environments. (2)

Diversity - The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan. (2) (1)

Douglas-Fir Type - An association of tree species in which Douglas-fir is recognized as one of the principal seral species.

Duff - Organic matter in various stages of decomposition on the floor of the forest. (4)

- E -

Edge - An area where plant communities meet or where successional stages or vegetation conditions within the plant communities come together. (2)

Effects - Environmental changes resulting from a proposed action. Included are direct effects, which are caused by the action and occur at the same time and place, and indirect effects, which are caused by the action and are later in time or further removed in distance, but which are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.
Effects and impacts as used in this document are synonymous. Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic quality, historic, cultural, economic, social, or healthy effects, whether direct, indirect, or cumulative. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agency believes that the effects will be beneficial. (40 CFR 1508.8, 2)

Ejecta - Material expelled forcibly from an erupting volcano, as opposed to lava flows.

Endangered species - Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.(6)

Environmental Analysis - A comprehensive evaluation of alternative actions and their predictable short- and long-term environmental effects, which include physical, biological, economic, social, and environmental design factors and their interactions. (2)

Environmental Assessment - The concise public document required by the regulations for implementing the procedural requirements of the National Environmental Policy Act. (40 CFR 1508.9, 2)

Environmental Impact Statement (EIS) - A statement of the environmental effects of a proposed action and alternatives to it. It is required for major federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. It is a formal document that must follow the requirements of NEPA, the Council on Environmental Quality (CEQ) guidelines, and directives of the agency responsible for the project proposal. (6)

Ephemeral draw - A drainage way which conveys surface water for short periods of time in direct response to snowmelt or rainfall runoff.

Even-aged stands - Stands in which all trees are of about the same age. (A spread of 10 to 20 years is generally considered one age class.) Cutting methods producing even-aged stands are clearcut, shelterwood, or seed tree systems.

- F -

Fire management - All activities required for protection of resources from fire and for the use of fire to meet land management goals and objectives. (6)

Fire return interval - The length of time between major, landscape level, stand replacement fire occurrences within a watershed or other large landscape. This term does not apply to a given acre and does not indicate the maximum age that forests attain in the area. It is simply an indication of the periodicity of large fires in the watershed.

Fire rotation - The time period between stand-replacing fire events on a given acre, stand, or site. While this figure may be most accurately used as an average of the periods between stand replacing fires, it is most frequently used to refer to the time between the last two events since dates of all fires which have affected a given site are usually not known.

Fisheries habitats - Streams, lakes, and reservoirs that support fish populations.

Flood plain - The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a one percent or greater chance of flooding in any given year. (2)

Floristic - Relating to flowering plants.

Forage - All browse and nonwoody plants that are available to livestock or game animals and used for grazing or harvested for feeding. (6)

Foreground - A term used in visual management to describe the portions of a view between the observer and up to 1/4 to 1/2 mile distant. (6)

Forest system roads - Roads that are part of the Forest development transportation system, which includes all existing and planned roads as well as other special and terminal facilities designated as Forest
development transportation facilities. (See arterial roads, collector roads, and local roads.)

Fuel management - The practice of planning and executing the treatment or control of living or dead vegetative material in accordance with fire management direction. (10)

Fuel treatment - The rearrangement or disposal of natural or activity fuels (generated by management activity, such as slash left from logging) to reduce fire hazard. Fuels are defined as both living and dead vegetative materials consumable by fire.

Fuels - Combustible wildland vegetative materials. While usually applied to above ground living and dead surface vegetation, this definition also includes roots and organic soils such as peat. (10)

- G -

Geomorphic - The formation of geologic and topographic features.

Glaciation - Erosion and deposition of soil and rocks by movement of glacial ice.

Guilds, Guilding - Classes of wildlife relating to their habits and environment.

Group selection cutting - See Uneven-aged silvicultural systems.

- H -

Habitat Effectiveness Indices - A numerical quantification of various big-game habitat qualities.

Headwaters - The upper tributaries of a river. (4)

Hiding cover - Vegetation that will hide 90 percent of an adult deer or elk from the view of a human at a distance of 200 feet or less. The distance at which the animal is essentially hidden is called a "sight distance."

Historic site - Site associated with the history, tradition, or cultural heritage of national, state, or local interest, and of enough significance to merit preservation or restoration. (6)

Hydrology - The scientific study of the properties distribution and effects of water in the atmosphere, on the earth's surface, and in soil and rocks.

- I -

ID Team - See Interdisciplinary team.

Impacts - See Effects.

Indicator species - See Management indicator species.

Infrastructure - The collection of facilities (roads, campgrounds, structures, transportation corridors, power transmission lines, antenna) constructed to facilitate administration of land.

Interior habitat - Forest habitat that is not affected by adjacent non-forest or young forest. Forest habitat with no edge effects.

Intermittent Stream - A stream that runs water in most months, but does not run water during the dry season during most years.

Issue - A point, matter, or question of public discussion or interest to be addressed or decided through the planning process. (See also Public issue.) (2)

- J,K -

Key Watershed - A Watershed containing populations of species at risk, containing potential habitat, or especially high quality water as designated by the Northwest Forest Plan.

- L -

Landing - Any place where round timber is assembled for further transport, commonly with a change of method. (3)

Lands Not Suited (Unsuitable) for Timber Production - Includes lands that: 1) are not forest land as defined in CFR 219.3; 2) are likely, given current technology, to suffer irreversible resource damage to soils productivity, or watershed conditions; 3) cannot be adequately restocked as provided in 36 CFR
219.27(c)(3); or, 4) have been withdrawn from timber production by an Act of Congress, the Secretary of Agriculture, or the Chief of the Forest Service. In addition, Forest lands other than those that have been identified as not suited for timber production shall be reviewed and assessed prior to formulation of alternatives to determine the costs and benefits of a range of management intensities for timber production. (1)

Landtype - A portion of the Forest mapped in the Soil Resource Inventory that has a defined arrangement of specific landforms that reacts to management activities in generally predictable ways. Landtypes range from 60 to 600 acres in size.

Large woody material (LWM) - Fallen large trees in streams or on the ground in terrestrial environments.

Late Successional - A vegetation type, usually forest, that is mature or old., Also old-growth.

Late Successional Reserve (LSR) - An area set aside from harvest and road building for species requiring late-succession habitat or interior habitat.

Lichens - Any of a large group of plants consisting of symbiotic fungi and algae.

Lithology, Lithologic - relating to rocks.

Low Flow - Minimum stream flows in summer or fall.

- M -

Management Area - An area with similar management objectives and a common management prescription. (1) (10)

Management direction - A statement of multiple use and other goals and objectives, and the associated management prescriptions, and standards and guidelines for attaining them. (1)

Management indicator species - A species selected because its welfare is presumed to be an indicator of the welfare of other species using the same habitat. A species whose condition can be used to assess the
impacts of management actions on a particular area. (8)

Mass movement - A general term for any of the variety of processes by which large masses of earth material are moved downslope by gravitational forces - either slowly or quickly. (6)
See Debris torrent and Deep-seated mass movement.

Mass wasting - Mass movement.

Matrix - That land outside of various reserves which is to be managed for timber production, among other objectives; designated by the Northwest Forest Plan.

Mature timber - Trees that have attained full development, particularly height, and are in full seed production. (3)

Maximum modification - See Visual quality objective.

Mesic - Moist, referring to a soil or site.

Middleground - A term used in visual management to describe the portions of a view extending from the foreground zone out to 3 to 5 miles from the observer. (6)

Mineral soil - Weathered rock materials usually containing less than 20 percent organic matter. (6)

Mitigation - Mitigation includes: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or elimination the impact over time by preservation and maintenance
operations during the life of the action; and, (e) compensating for the impact by replacing or providing substitute resources or environments. (40 CFR Part 1508.20)

Modification - See Visual quality objective.

Monitoring and evaluation - The periodic evaluation of Forest Plan management practices on a sample basis to determine how well objectives have been met.

Morphometry - Measurement of the morphology or form, as in lake bottom shapes.

Municipal Watershed - A watershed which provides water for human consumption, where Forest Service management could have a significant effect on the quality of water at the intake point, and that provides water utilized by a community or any other water system that regularly serves: 1) at least 25 people on at least 60 days in a year, or 2) at least 15 service connections. In addition to cities, this includes campgrounds, residential developments, and restaurants. (10)

- N -

National Environmental Policy Act (NEPA) of 1969 - An Act to declare a National policy which will encourage productive and enjoyable harmony between humankind and the environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, to enrich the understanding of the ecological systems and natural resources important to the Nation, and to establish a Council on Environmental Quality. (The Principal Laws Relating to Forest Service Activities, Agriculture Handbook No. 453, USDA, Forest Service, 359 pp.)

National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of Regional Guides and Forest Plans and the preparation of regulations to guide that development.

Natural regeneration - Reforestation of a site by natural seeding from the surrounding trees. Natural regeneration may or may not be preceded by site preparation.

Nephalometric Turbidity Unit - A relative quantification of water turbidity.

Nonpoint source pollution - Pollution whose source is general rather than specific in location. It is widely used in reference to agricultural and related pollutants-- for example, production of sediments by logging operations, agricultural pesticide applications, or automobile exhaust pollution. (6)

Noxious weeds - Undesirable, usually non-native, plant species that are unwholesome to the range or to animals or compete with native plants. (6)

- O -

Objective - A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals. (1)

Old-growth stand (old growth) - Any stand of trees 10 acres or greater generally containing the following characteristics:) contain mature and overmature trees in the overstory and are well into the mature growth stage; 2) will usually contain a multilayered canopy and trees of several age classes; 3) standing dead trees and down material are present; and 4) evidences of man's activities may be present, but do not significantly alter the other characteristics and would be a subordinate factor in a description of such a stand. (2)

Oligotrophic - Referring to bodies of water, a condition of very low levels of dissolved or suspended nutrients.

Optimal cover - Habitat for deer and elk which has tree overstory and understory, shrub and herbaceous layers; the overstory canopy generally exceeding 70% crown closure and dominant trees generally exceed 21 inches d.b.h.; provides snow intercept, thermal cover, and forage.

Overstory - That portion of the trees, in a Forest or in a stand of more than one story, forming the upper or uppermost canopy. (3)

- P -

PAOT - Persons at one time.

Partial retention - See Visual quality objective.

Particulates - Small particles suspended in the air and generally considered pollutants. (See Total Suspended Particulates.) (5)

Perennial stream - A stream that flows year round.

Peak flow - The highest amount of stream or river flow accruing in a year or from a single storm event.

Pests - Any animal or plant that, during some portion of its life cycle, inhibits the establishment or growth of some other species of plant or animal favored by man.

Phonology - The science dealing with the influence of climate on the recurrence of such annual phenomena of animal and plant life as bird migrations, budding, etc. (4)

Planning area - The area of the National Forest System covered by a Regional guide or forest plan. (1)

PMIO emissions - Air born particulates less than or equal to 10 microns in diameter.

Prehistoric site - An area which contains important evidence and remains of the life and activities of early societies which did not record their history.

Precommercial Thinning - Thinning of small trees when no income is derived from the trees and cut trees are generally not removed from the site.

Prescribed fire - A wildland fire burning under specified conditions which will accomplish certain planned objectives. The fire may result from either planned or unplanned ignitions. Proposals for use of unplanned ignitions for this purpose must be approved by the Regional Forester. (2)

Prescription - A written direction for harvest activities and regeneration methods.

Primary cavity excavators - Wildlife species that excavate cavities in snags.

Primary productivity - the portion of biological activity and production attributed to plant life.

Pruning - Removing of limbs from the lower portion of a tree.

Public Involvement - A Forest Service process designed to broaden the information base upon which agency decisions are made by (1) informing the public about Forest Service activities, plan, and decisions, and (2) encouraging public understanding about and participation in the planning processes which lead to final decision making. (10)

Pumice - A light, frothy volcanic rock formed by explosive eruptions.

Pyroclastic - Rock formed in volcanic eruptions that is composed of broken fragments.

- Q -

Quark - Smallest subatomic particle known to man.

- R -

Raptors - Predatory birds, such as falcons, hawks, eagles, or owls.

Reforestation - The natural or artificial restocking of an area with forest trees. (2)

Regeneration - The renewal of a tree crop, whether by natural or artificial means. Also, the young crop itself, which is commonly referred to as reproduction. (2)

Rehabilitation - Action taken to restore, protect, or enhance site productivity, water quality, or other resource values over a period of time .

Release - The cutting of competing and unwanted vegetation to free conifers for growth.

Residual stand - The trees remaining standing after some activity such as selection cutting or an occurrence such as fire or windthrow. (2)

Retention - See Visual quality objective.

Riparian - Pertaining to areas of land directly influenced by water or influencing water. Riparian areas usually have visible vegetative or physical characteristics reflecting this water influence. Stream sides, lake borders, or marshes are typical riparian areas. (3)

Riparian Reserve - A protected area along streams and wetlands.

Roadless Area - Areas studied during the Roadless Area Review and Evaluation process (RARE II) which are roadless and at least 5,000 acres in size.

Rotation - Planned number of years between the formation of a generation of trees and its final harvest at a specified stage of maturity. Appropriate for even-aged management only. (6)

Rotational failure - A general term for a mass movement landform and a process characterized by a slope in which shearing takes place on a well defined, curved shear surface, concave upward, producing a backward rotation in the displaced mass. The landform may be single, successive (repeated up- and down-slope), or multiple (as the number of slide components increases).

- S -

Salmonid - The family of fish species including salmon, trout, and char (whitefish).

Salvage cuttings - Intermediate cuttings made to remove trees that are dead or in imminent danger of being killed by injurious agents. (10)

Scarified - Land in which the topsoil has been broken up or loosened in preparation for regenerating by direct seeding or natural seedfall. Also refers to ripping or loosening road surfaces to a specified depth for obliteration or "putting a road to bed." (3)

Second growth - Forest growth that has become established following some interference, such as cutting, serious fire, or insect attack, with the previous Forest crop. (6)

Sediment - Earth material (rocks, gravels, sands, silts, clays) transported, suspended, or deposited by water. (6)

Seed tree cutting - Removal in one cut of the mature timber from an area, except for a small number of seed bearers left singly or in small groups. (3)

Selection cutting - The annual or periodic removal of trees (particularly mature trees), individually or in small groups, from an uneven-aged forest, to realize the yield and establish a new crop of irregular constitution. (3)

Sensitive species - Plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species, that are on an official State list, or that are recognized by the Regional Forester as needing special management to prevent placement on Federal or State lists. (2)

Sensitivity analysis - A determination of the effects of varying the level of one or more factors, while holding the other factors constant. (6) (10)

Seral - A stage in plant community development.

SHAB, Special Habitats - Areas set aside by the Willamette National Forest Plan to protect unique plant and animal habitats.

Shelterwood - The cutting method that describes the silvicultural system in which, in order to provide a source of seed and/or protection for regeneration, the old crop (the shelterwood) is removed in two or more successive shelterwood cuttings. The first cutting is ordinarily the seed cutting, though it may be preceded by a preparatory cutting, and the last is the final cutting. Any intervening cutting is termed removal cutting. An even-aged stand results. (3)

Silviculture - The art and science of controlling the establishment, composition, and growth of forests. (2)

Site preparation - 1)An activity (such as prescribed burning, disking, and tilling) performed on a reforestation area, before introduction of reforestation, to ensure adequate survival and growth of the future crop; or 2)manipulation of the vegetation or soil of an area prior to planting or seeding. The manipulation follows harvest, wildfire, or construction in order to encourage the growth of favored species. Site preparation may include the application of herbicides; burning, or cutting of living vegetation that competes with the favored species; tilling the soil; or burning of organic debris (usually logging slash) that makes planting or seeding difficult.

Skidding - A general term for hauling loads by sliding, not on wheels, as developed originally from stump to roadside, deck, skidway, or other landing. (3)

Skyline Logging - A system of cable logging in which all or part of the weight of the logs is supported during yarding by a suspended cable.

Slash - The residue left on the ground after tree felling and tending, and/or accumulating there as a result of storm, fire, girdling or poisoning. It includes unutilized logs, uprooted stumps, broken or uprooted stems, the heavier branchwood, etc. (3)

Snag - A standing dead tree.

Soil productivity - The capacity of a soil to produce a specific crop such as fiber or forage under defined levels of management. Productivity is generally dependent on available soil moisture and nutrients, and length of growing season.

Soil resource inventory - See Land Type.

Special Interest Areas - Areas managed to make recreation opportunities available for the understanding of the earth and its geological, historical, archeological, botanical, and memorial features. (6)

Special Forest Products (SFPs) - Forest resources that are not associated with timber sale contracts. May be for commercial or personal use. Some common SFPs include greenery, mushrooms, live plants, cones, berries, etc.

Special Wildlife Habitat - A habitat which is unique and has a special function not provided by plant communities or Successional stages; includes riparian zones, wetlands, cliffs, caves, talus, and meadows.

Stand (tree stand, timber stand) - An aggregation of trees or other vegetation occupying a specific area and sufficiently uniform in species composition, age arrangement, and condition as to be distinguishable from the forest or other vegetation or land cover on adjoining areas. (2)

Stand diversity - Any attribute that makes one timber stand biologically or physically different from other stands. This difference can be measured by, but not limited to: different age classes; species; densities; or non-tree floristic composition.

Stand replacement fire - Fire that kills most or all of a stand of trees, creating space for a new stand to begin.

Standards and Guidelines - Principles specifying conditions or levels of environmental quality to be achieved.

Stream Buffer - Vegetation left along a stream channel to protect the channel or water from the effects of logging, road building, or other management activity.

Stream Class - Classification of streams based on the present and foreseeable uses made of the water, and the potential effects of on-site changes on downstream uses. Four classes are defined:

Class I - Perennial or intermittent streams that: provide a source of water for domestic use; are used by large numbers of anadromous fish or significant sports fish for spawning, rearing or migration; and/or are major tributaries to other Class I streams.
Class II - Perennial or intermittent streams that: are used by fish for spawning, rearing or migration; and/or may be tributaries to Class I streams or other Class II streams.
Class III - All other perennial streams not meeting higher class criteria.
Class V - All other intermittent streams not meeting higher class criteria. (10)

Stream Structure - The arrangement of logs, boulders, and meanders which modify the flow of water, thereby causing the formation of pools and gravel bars in streams. Generally, there is a direct relationship between complexity of structure and fish habitat. Complex structure is also an indication of watershed stability.

Subdrainage - Areas used for planning and analysis. It is based on tributary drainage boundaries and averaging 2000 to 4000 acres.

Subwatershed - A subdivision of a watershed equivalent to the 6th field subwatersheds as presented in the PACFISH report. These are larger than subdrainages.

Suitability - The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices. (1) (2) (FSM 1905)

Succession - A series of changes by which one group of organisms succeeds another through stages leading to a potentially stable climax community.

Suppression - The process of extinguishing or confining fire. (2)

System Road - A road meant to be used in the future with an established maintenance schedule.

- T -

Territory - The area which an animal defends, usually during breeding season, against intruders of its own species.

T. E. and S. species - Threatened, endangered and sensitive species, both plant and animal.

Thermal cover - Cover used by animals to ameliorate effects of weather.

Thinning - A felling made in an immature stand primarily to maintain or accelerate diameter increment and also to improve the average form of the remaining trees without permanently breaking the canopy. An intermediate cutting. (3)

Threatened and Endangered (T&E) species - See Threatened; see Endangered.

Threatened species - Those plant or animal species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future. (See also Endangered species.) (2)
Till - An unsorted mixture of clays, silts, sands, gravels and rocks deposited by glaciers.

Tractor logging - Any logging method which uses a tractor as the motive power for transporting logs from the stumps to a collecting point--whether by dragging or carrying the logs. (3)

Transient snow zone - That area where snowfall tends to melt soon after it falls, such that accumulation waxes and wanes through the winter .

Travel Corridor - A route followed by animals along a belt or band of suitable cover or habitat.

Tuff, Tuffaceous - Material made up of volcanic ash deposits.

Turbidity - The degree of opaqueness, or cloudiness, produced in water by suspended particulate matter, either organic or inorganic. Measured by light filtration or transmission and expressed in Jackson Turbidity Units (JTUs).

- U -

Ultra oligatrophic - Very, very clean, clear water.

Underburn - Fire, natural or prescribed, which burns only on the forest floor with an intensity such that dominant trees are typically not killed.

Understory - The trees and other woody species growing under a more-or-less continuous cover of branches and foliage formed collectively by the upper portion of adjacent trees and other woody
growth. (6)

- V -

Viewshed - Portion of the Forest that is seen from a major travel route, or high use location.

Visual quality objective (VQO) - Categories of acceptable landscape alteration measured in degrees of deviation from the natural-appearing landscape.

Preservation (P) - Ecological changes only.
Retention (R) - Management activities should not be evident to the casual Forest visitor.
Partial Retention (PR) - Management activities remain visually subordinate to the characteristic landscape.
Modification (M) - Management activities may dominate the characteristic landscape but must, at the same time, follow naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.
Maximum Modification (MM) - Human activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.
Enhancement - A short-term management alternative which is done with the express purpose of increasing positive visual variety where little variety now exists. (2)

Visual resource - The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for visitors. (2)

- W -

Watershed - The entire land area that contributes water to a major drainage system or stream as designated by the FEMAT Report.

Wetlands - Areas that are inundated by surface or ground water often enough to support, and usually do support, primarily plants and animals that require saturated or seasonally saturated soil conditions for growth and reproduction. (E.O. 11990)

Wild and Scenic river - Those rivers or sections of rivers designated as such by Congressional action under the 1968 Wild and Scenic Rivers Act, as supplemented and amended, or those sections of rivers designated as wild, scenic, or recreational by an act of the legislature of the state or states through which they flow. Wild and scenic rivers may be classified and administered under one or more of the following categories:

1. Wild River Areas - Those rivers or sections of rivers that are free of impoundment's and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted.
2. Scenic River Areas - Those rivers or sections of rivers that are free of impoundment's, with watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
3. Recreational River Areas - Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past. (2) (6)

WIN, Watershed Improvement needs - A systematic survey of watershed conditions.

Winter Range - An area used by deer and elk during the winter months; usually at lower elevation and/or on south and west exposures.

Woody Material - Organic materials necessary for stream channel stability and maintenance of watershed condition. It includes large logs and root wads.

- X,Y,Z -

Xeric - Dry, referring to soil or site.

Yarding - Hauling timber from the stump to a collection point. (2)

APPENDIX N:

Analysis Team Members

All the team members listed below are employees of the Willamette National Forest on the Lowell, Rigdon, or Oakridge Rangers Districts.

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Botanist

Jim Minogue
GIS

David Murdough
Team Leader, Soil Scientist

Debby Murdough
Information Management Coordinator

Dede Steele
Wildlife Biologist

Dennis Sulivan
Fuels Specialist

Nikki Swanson
Fish Biologist

Mike Williams
Engineering Specialist

Carol Winkler
Archaeologist

APPENDIX O:

Public And Agency Contacts

The following individuals, groups, businesses, and/or government agencies provided information during this Watershed Analysis.

Open House Public Meeting:
(507 meeting announcements were mailed to interested individuals, groups, and government agencies)

Attendees included-

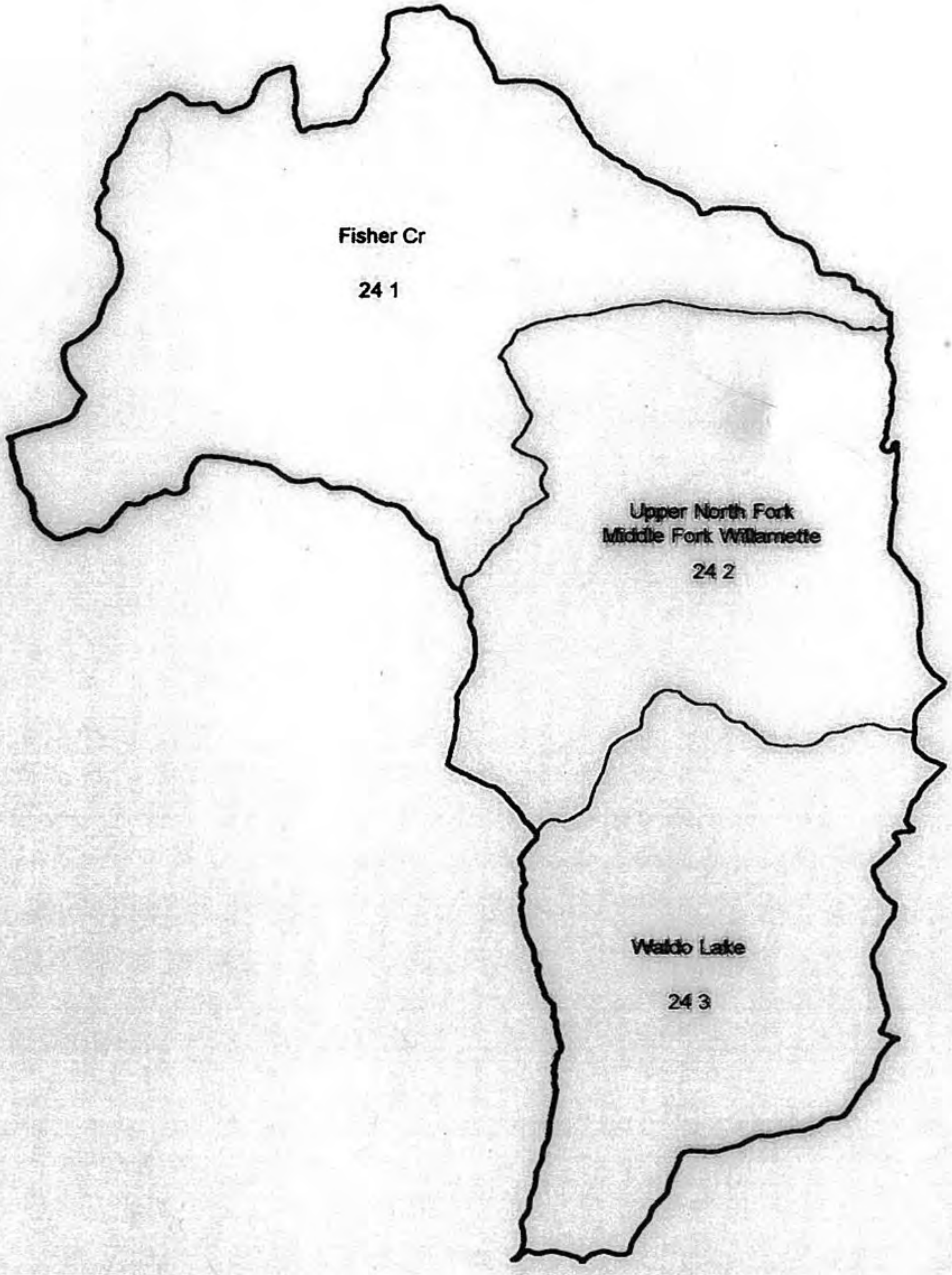
Bud LaDuke
Merrilee Peavy
Peggy Robinson
Tom Graves
Julie Stangell
Roy and Katsy Vermillion
Hugh Kern
Allen Barneburg
Trish Wilson
Lee Inkmann

State and Federal Agencies:
City of Westfir, Jerry Love
Oregon Department of Fish and Wildlife, Jeff Ziller
U.S. Environmental Protection Agency, Bruce Cleland
U.S. Fish and Wildlife Service, Ray Bosch
U.S. Forest Service, Deschutes National Forest, Crescent Ranger District, Dave Royer
U.S. Forest Service, Willamette and Siuslaw National Forests, Karen Austin, Zone Wildlife Ecologist
U.S. Forest Service, Willamette National Forest (Numerous people were consulted on the Forest regarding information)
U.S. Geological Survey Water Resources Division, Jo Miller

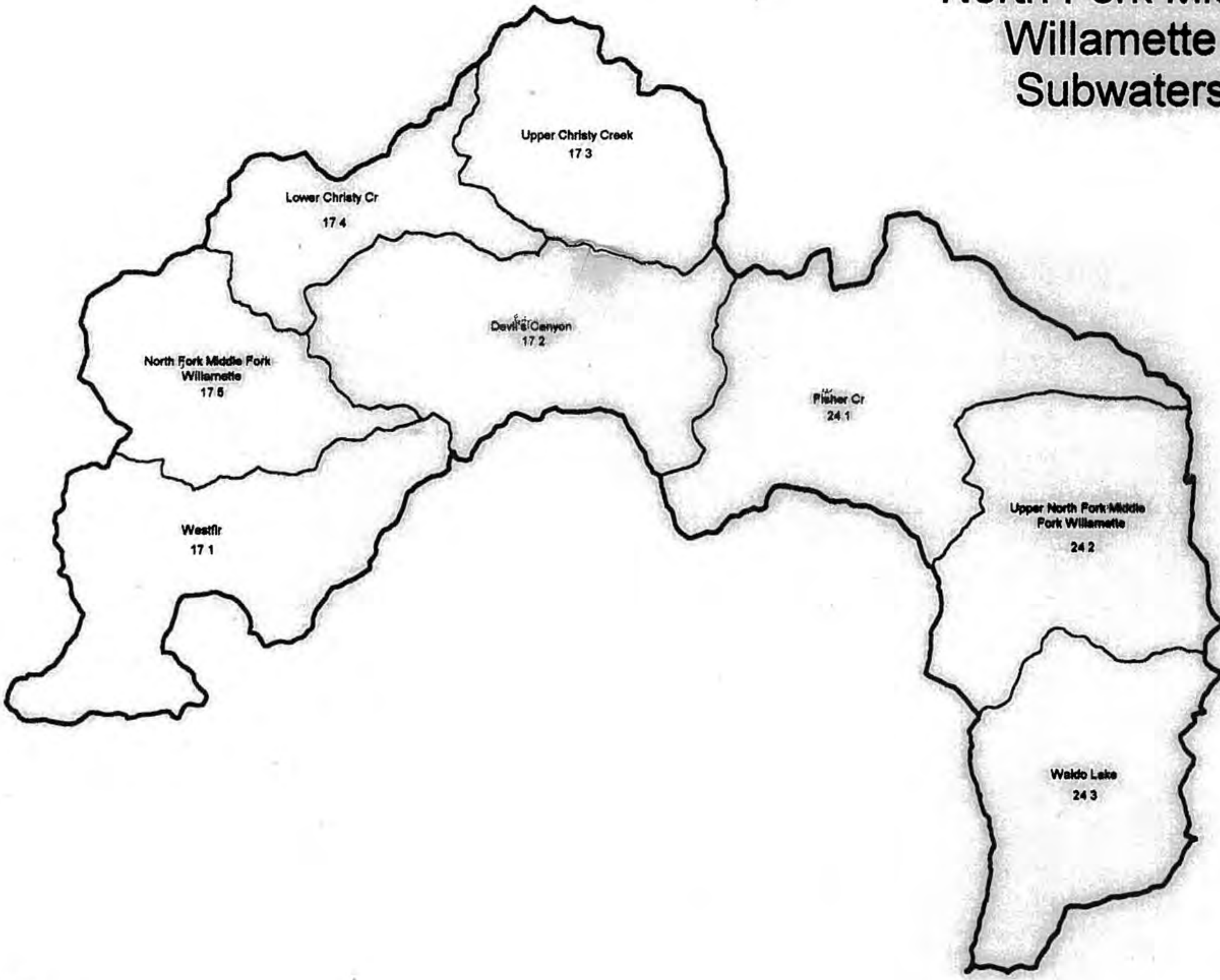
Interested Individuals, Local Businesses, and Groups:

Bob, Diamond Lake Resort
Bruce Baker, Diamond Lake Resort
Caddis Fly, Eugene, OR
Dwight Chitwood, Oakridge Best Western Inn
Chuck's Rod and Reel, Eugene, OR
Paul Kemp
Ken and Jerry, Westfir Lodge Bed and Breakfast
Jim Kirkheart, Dink's Market
Joe Kuharic
Doug Larson, Waldo Lake Researcher
Bruce Mason, University of Oregon, Outdoor Program
Jim Read, Willamette Kayak and Canoe Club
Skeeter Roach, Mountain View Sentry Market
Sportsman's Cafe (interviews with 5 customers)
Dave Ruter, Collins Cycle, Eugene, OR
Edna Wafler, Oakridge Motel

Upper North Fork Middle Fork Willamette River Watershed Sub-watersheds



North Fork Middle Fork Willamette River Subwatersheds



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Lower North Fork Middle Fork Willamette River Watershed Sub-watersheds