McKenzie Watershed Council

Technical Report
for

Water Quality and Fish and Wildlife Habitat

February 1996

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Abstract

This document is the McKenzie Watershed Council's Technical Report for water quality and fish and wildlife habitat. The Technical Report provides the framework for the goals, objectives, actions, and specific tasks outlined in the McKenzie Watershed Council Action Plan. This report is a supplement to the Action Plan, providing additional technical background and analysis used in developing the Action Plan.

This Report's companion document, the Action Plan, contains the council's goals and priority actions regarding water quality and fish and wildlife habitat issues. These actions are intended to be implemented during the next 18 to 24 months, involving council partner organizations and other private and public stakeholders.

Acknowledgments

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Technical advice for this document was provided by a Water Quality Task Group and Fish and Wildlife Habitat Task Group assembled by the watershed council.

Table of Contents

Chapter Four. Sub-Watershed Fish and Wildlife Habitat Conditions

Chapter Five. Priority Actions Selection Process and Possible Future Actions

Chapter Six. Monitoring/Evaluation/Implementation

Figures

Tables

Maps

Appendices

Chapter One

Introduction

I. Purpose

This document is the McKenzie Watershed Council's Technical Report for water quality and fish and wildlife habitat. The Technical Report provides the framework for the goals, objectives, actions, and specific tasks outlined in the McKenzie Watershed Council Action Plan. This report is a supplement to the Action Plan, providing additional technical background and analysis used in developing the Action Plan. Contents of this report include: a characterization of the McKenzie watershed and sub-watersheds; documentation of work completed by the technical advisors to the Watershed Council; a listing of all recommended actions to date; and how the council will continue to monitor and evaluate the watershed's health and effectiveness of council actions. Appendices include: lists of possible future action steps, lists of technical advisors for the McKenzie Watershed Program, wildlife species list, acronyms, cited references, and other resources.

This Report's companion document, the Action Plan, contains the council's goals and priority actions regarding water quality and fish and wildlife habitat issues. These actions are intended to be implemented during the next 18 to 24 months, involving council partner organizations and other private and public stakeholders. Like the Action Plan, this Technical Report only addresses the water quality and fish and wildlife habitat portion of the council's work program. As the council addresses new issues, such as recreation and human habitat, new recommendations will be made and documents produced regarding those specific issues. Additional information on the creation of the McKenzie Watershed Council and development and implementation of the Integrated McKenzie Watershed Management Program can be found in the document: *How the McKenzie Watershed Council Got Started*, May 1995.

Two groups of technical advisors were assembled to undertake the water quality and fish and wildlife habitat topics. Charges given to the technical advisors included:

1. Evaluate existing conditions,
2. Identify problem areas,
3. Define desired conditions, and
4. Recommend actions to bring current conditions in-line with the desired conditions.

This Technical Report is the outcome of the first two of these charges from which the Action Plan, defining desired conditions and recommended actions, was derived.

II. Document Organization

This report is organized into six chapters and is supplemented by a series of appendices.

Chapter One, *Introduction,* describes the purpose of the Technical Report and its relationship to the Action Plan. In addition, this chapter outlines the Technical Report's organization and describes how the report can be used.

Chapter Two, *Basin Characterization*, establishes an overview of the general setting, and the human and natural resources of the McKenzie watershed. This chapter provides both the historical and current characteristics of the watershed that contribute to the integrated approach of the McKenzie Watershed Council.

Chapter Three, *Existing Conditions for Water Quality and Fish and Wildlife Habitat,* presents current information about water quality and fish and wildlife habitat in the McKenzie watershed. Chapter sections parallel Action Plan goals and include a more detailed discussion of: water quality, water quantity, riparian areas and floodplains, stream habitat, and uplands.

Chapter Four, *Sub-watershed Conditions for Fish and Wildlife Habitat*, provides information about existing conditions regarding fish and wildlife habitat for each of the ten sub-watersheds within the McKenzie watershed. This chapter presents land ownership, vegetation types, fish distribution, and known riparian and stream habitat quality.

Chapter Five, *Priority Action Selection Process and Possible Future Actions*, describes the process the council used in identifying its priority actions related to water quality and fish and wildlife habitat. Included is a list of brainstormed actions related to water quality and fish and wildlife habitat. It was from these lists that the council's priority action clusters were identified. The council's priority action clusters are explained in detail in the Action Plan. Additional action proposals are included as an appendix for future consideration by the council.

Chapter Six, *Monitoring, Evaluation and Implementation,* provides the framework and additional technical background used in developing the council's water quality and fish and wildlife monitoring strategy. The section on the benchmark system describes the methods that the McKenzie Watershed Council will use to monitor watershed health and evaluate the effectiveness of council actions. Finally, the chapter provides the technical background and analysis used in the development of the watershed-wide water quality monitoring program and wildlife habitat assessment.

The *Appendices* include the council program objectives, lists of task groups, wildlife species list, a comprehensive list of actions the council has considered, acronyms, references, and other available resources.

Chapter Two

Watershed Characterization

I. Introduction

This chapter provides an overview of the general setting and the human and natural resource characteristics of the McKenzie watershed. Historical and current characteristics of the watershed establish a baseline indicator from which future and desired conditions can be established. Supporting maps, figures, and tables portray many of the characteristics discussed. These follow relevant sections of this chapter.

The general setting section presents a description of the watershed's location, size, and boundaries. In addition, a discussion of the watershed's regions, stream system, geology and soils, and climate is provided. These characteristics often vary within different regions of the 1,300-square-mile watershed.

Water, fish, and vegetation and wildlife habitats are the principal natural resources currently of interest to the McKenzie Watershed Council. Water quality and quantity are important aspects for human, fish, and wildlife needs The McKenzie watershed is home to many fish and wildlife species. As with many systems in the Pacific Northwest, fish and wildlife habitats have changed over time influencing population levels.

Since the 19th century, human use of and settlement in the McKenzie watershed has changed from native American annual migrations to early European explorers and homesteaders to its present land use. Currently, the majority of the watershed is in public ownership, with the majority of that being held by the National Forest. Most private lands are held by timber companies. The watershed is valued for its forest production, recreation opportunities, and scenic beauty.

Most people living in the McKenzie watershed reside in urban areas. Population trends in the rural parts of the watershed reflect shifts in jobs and opportunities. Similar to other areas of the state, farming and forestry occupations in the McKenzie area have dropped.

II. General Setting

A. Location, Size, and Boundaries

Map 1 (page 7) displays the McKenzie watershed location, relative size, and boundaries. The watershed encompasses an area of approximately 1300 square miles, occupying about 12 percent of Oregon's Willamette basin. More than 80 percent of the watershed lies within Lane County with the remaining portion in Linn County. Bounded on the east by the crest of the Cascade Mountains, the McKenzie watershed generally drains westward joining the Willamette River, just north of the Eugene-Springfield metropolitan area.

Tracing the watershed boundary from the confluence with the Willamette River in a clockwise direction, the McKenzie watershed's northern boundary follows the ridgeline of the Coburg Hills between Muddy Creek and the Mohawk River north to the county line. Turning east along the county line, the northern boundary follows along the ridgeline separating the Kalapuya Basin from the Mohawk Basin. Then, it follows along the McKenzie/Santiam River divide (Lane/Linn county line) until the divide jogs north of the county line to the Santiam Pass and on east to the crest of the Cascade Mountains to encompass the Blue River drainage and the southerly flowing upper stretch of the McKenzie River above Belknap Hot Springs.

The crest of the Cascade Mountains forms the eastern boundary. The southern boundary follows the ridgeline separating the North Fork of the Middle Fork of the Willamette River Basin from the French Pete Basin and the South Fork McKenzie Basin. Continuing west along the ridgeline, the boundary separates the Fall Creek Basin from the McKenzie Basin until it passes through the north-east portion of the Eugene-Springfield metropolitan area then turns north to the confluence with the Willamette River, just south of the city of Coburg.

B. Physiographic Regions

The shaded relief *Map 2* (page 9), gives a sense of the lay of the land in the McKenzie basin. Much of the watershed is mountainous with elevations ranging from about 375 feet above sea level near the river's mouth to 10,358 feet at the summit of South Sister. Approximately 90 percent of the watershed lies above 1,000 feet in elevation and 70 percent is above 2,000 feet. Most of the basin consists of steep ridges with a narrow band of level land in the valleys along the McKenzie and Mohawk rivers. Upper reaches of the McKenzie River flow through a lava plateau 5,500, to 6,000 feet in elevation with the floodplain broadening downriver below Deerhorn.

Natural features divide the McKenzie watershed into three general regions the High Cascades, the Western Cascades and the Willamette Valley, shown in *Map 3* (page 11). These physiographic regions, as geographers call them, are areas of land formed by the same processes.

The High Cascades form the easternmost portion of the watershed. Geologically young, this high elevation area (above 6,000 feet) has heavily glaciated volcanic peaks reaching above 10,000 feet with lava flows and many small and a few large lakes formed by glaciation.

Most of the McKenzie watershed west of the High Cascades lies within the Western Cascades region. Geologic features in this region are older than the High Cascades, consisting of deeply dissected volcanic mountains (below 6,000 feet) that rise abruptly from the Willamette Valley. Steep ridges in this region generally run east-west, steadily gaining elevation towards the east.

The westernmost portion of the watershed (near Springfield) is in the Willamette Valley region, a broad, level to gently sloping area of bottomlands and terraces formed from alluvial deposits. The elevation in this region is low, around 430 feet in the metropolitan area.

C. Stream System

The mainstem of the McKenzie River originates in the northeast portion of the watershed at Clear Lake, which lies at an elevation of 3000 feet just outside the northwest corner of the Mount Washington Wilderness Area. From Clear Lake, the river flows southward for 15 miles to Belknap Springs and then turns sharply westward for 75 miles before emptying into the Willamette River just south of the community of Coburg.

Several principal tributaries drain into the McKenzie River as shown in *Map 4* (page 13). Lost Creek, Horse Creek, South Fork McKenzie River and Quartz Creek join the McKenzie from the south. Of these, all except Quartz Creek originate in the high Cascades with Lost and Horse Creek being fed from glaciers on the west flank of the Three Sisters mountains. Smith River, Blue River, Gate Creek, Camp Creek and the Mohawk River are the principal tributaries joining from the north. In all, there are about 1,780 stream miles, of which approximately 1,040 miles flow year round (Water Resources Department, 1991).

D. Geology and Soils

The McKenzie watershed is made up primarily of volcanic, sedimentary, and alluvial geologic regions. The oldest rocks are exposed along the base of the Coburg Hills and consist of sandstone and siltstone (Water Resources Department, 1991).

The Cascade Range is made up primarily of volcanic rocks. The younger high Cascades are primarily dominated with lava flows, some less than 500 years old. Formations of basalts and rhyolites are found in the older western Cascades (Water Resources Department, 1991).

Sedimentary materials are found 200 to 300 feet above the valley floor, with such features particularly noticeable in the Mohawk Valley. Folding is evidenced along ridge tops and by some sedimentary dike out-crops in the Mohawk Valley.

Alluvial deposits, made up principally of coarse volcanic sand and gravel, extend far up the McKenzie River Valley. Much of this alluvium has been deposited along the lower stretch of the McKenzie River to form part of the Springfield delta (State Water Resources Board, 1991), and other deposits are found in the Mohawk River and Camp Creek valleys (Meacham, 1990). These alluvial deposits vary in depth, with older deposits ranging from 100 to 300 feet.

Glacial action is suspected of having placed gravel and rock deposits at various levels along the upper McKenzie valley. Cemented gravels in river bar formations are evident at elevations as high as 500 feet above the present valley floor in the Blue River area.

Agriculturally productive soils are generally found along the lower river valley bottomlands, with some of the most productive soils situated within the alluvium bottomlands of the Mohawk River. Soils positioned along the higher slopes are primarily suited for lower intensity cultivated crops, pasture, recreation, timber and wildlife. *Map 5* (page 15) displays the Soil Conservation Service's agricultural value classifications related to soil productivity for the watershed soil capability classifications.

Generally, bottomland and lower terrace soils have development limitations primarily due to susceptibility of flooding, high water table, and subsoil problems due to the water recharge from adjacent upland areas. Developments on soils positioned on the low foothills and higher terraces have limitations primarily due to excessive slopes, erosion hazards, rapid permeability, and high shrink-swell potential. Soils found on the gentle to steep dissected uplands and ridge-tops have considerable development limitations because of the extreme erosion hazards.

E. Climate

The climate in the McKenzie watershed varies from the lowlands of the Willamette Valley to the highlands in the Cascades. The climate in the Willamette Valley portion of the watershed is relatively mild throughout the year, characterized by cool, wet winters and warm, dry summers.

The average minimum temperature in Eugene, which is close to the western end of the watershed, is about 33 degrees Fahrenheit for the coldest month and the average maximum is about 82 degrees Fahrenheit for the warmest month. Corresponding temperatures for the coldest and warmest month at Belknap Springs in the eastern portion of the watershed are about 27 degrees and 81 degrees Fahrenheit (Oregon Climate Service, 1994).

Precipitation increases with rising elevation due to the condensation of moisture in the Pacific air currents which must rise to pass areas of higher elevation. Whereas average annual precipitation ranges from 40-50 inches in the Coburg-Springfield area, the average increases to 110 inches in the headwaters of Blue River (State Water Resources Board, 1961). Typically, about half of the annual precipitation in the watershed occurs in the winter, with lesser amounts during the spring and fall, and very little in the summer (Oregon Climate Service, 1994).

Most precipitation is in the form of rain in the lower elevations. Snow is generally short-lived in areas below 4,000 feet, with accumulations disappearing several times during the winter season, depending on temperature conditions. Above 4,000 feet, snow tends to accumulate, reaching a maximum depth during the month of May, with accumulations in excess of 90 inches occurring in the central Cascades (State Water Resources Board, 1961).

Map 1. Vicinity Map

Map 2. Shaded Relief Map

Map 3. Geology Map
w/ Physiographic Regions

Map 4. Hydro Layer
w/ Principal Tributaries and Dams

Map 5. Soils Map

III. Natural Resources

A. Water

With the headwaters originating in three wilderness areas, the McKenzie River contains some of the cleanest water in Oregon. The McKenzie watershed is the source of drinking water, both surface and groundwater, for approximately 200,000 area residents, most of whom do not live in the watershed. The Eugene Water & Electric Board (EWEB) alone supplied approximately 8.25 billion gallons of McKenzie water in 1993 to its customers from its water intake facility at Hayden Bridge. Springfield Utility Board (SUB) and Rainbow Water District obtain water from well fields in the aquifers north of Springfield. Many of the homes and businesses outside the metropolitan region derive drinking water from private wells. Other community water suppliers in the watershed include the Marcola, Shangri-La, McKenzie Palisades, and Blue River Water Districts, each of whom obtain their supplies from groundwater sources.

Major industries also rely on the McKenzie River for their water supply. Weyerhaeuser Company withdraws and cycles up to 20 million gallons per day for their industrial activities, which includes a pulp and paper mill, a cardboard recycling facility, and a particleboard plant (GEM,1995). Agripac Inc., a grower-owned food processing cooperative, uses about 435,600 gallons per day in their food processing operations. Growers in the valley use additional water for crop irrigation.

Steep gradients and the large volume of runoff make the McKenzie system a valuable hydroelectric resource. The six dams shown on *Map 2* (page 9), provide hydroelectric power and flood control. EWEB generates power through the operation of the Walterville and Leaburg Hydroelectric Projects on the lower McKenzie and three dams on the upper McKenzie at the Carmen-Smith and Trial Bridge Hydroelectric Projects. The Army Corps of Engineers (ACOE) also operates the Blue River Dam on Blue River and Cougar Dam on the South Fork of the McKenzie. While both the ACOE dams provide storage for flood control, flow augmentation and navigation functions, hydroelectricity is generated only at Cougar Dam. *Table 1* displays the power generation capacity of the major dams along the McKenzie and its tributaries.

Table 1
Power Generating Dams

Hydroelectric Projects	Power Generation Capacity (Megawatts)
Leaburg Power Plant	13
Walterville Power Plant	8
Carmen-Smith Hydro Project	90
Cougar Dam	34

Source: Conservation and Development of Rural Resources in Lane County

Natural flow patterns in the McKenzie River have been altered by dams, diversions, water withdrawals, roads, and changes in the landscape vegetation. Average annual river flows for the McKenzie River are 454 cubic feet per second (cfs) at the outlet of Clear Lake and 5,809 cfs near its confluence with Willamette at Armitage Park (USGS, 1995). Stream flows in the watershed approximate the seasonal precipitation patterns, peaking in February at approximately 10,200 cfs in the McKenzie River near Armitage Park and dropping to 2,020 cfs in September (USGS, 1993). The relatively high stream flow in the McKenzie is sustained during the early summer months since the porous lava beds of the high Cascades tend to release water from snowmelt gradually and at a uniform rate (State Water Resources Board, 1961). In addition, the summer flows are roughly one-third higher than normal due to the releases of Cougar and Blue River Reservoirs. There are indications that there may be significant groundwater sources discharging into the lower reaches of the McKenzie River as flows are 20 percent higher at Armitage Park than would be expected solely from overland sources (USGS, 1995).

B. Fish

The McKenzie watershed has over a thousand miles of perennial streams, of which most are fish bearing. Of the hundreds of natural lakes of varying sizes in the watershed, about 130 contain fish, as do each of the six reservoirs located in the watershed. There are 22 species of native fish in the McKenzie watershed and somewhere between seven and twelve introduced species. Most of the 22 native fish species found in the McKenzie River are found downstream from Leaburg Dam.

Several species of trout are found in the McKenzie watershed. Rainbow, cutthroat, and bull trout are native. Small populations of brook trout were also introduced into several high elevation lakes prior to 1960. Self-sustaining populations of brook trout occur down to Trail Bridge Reservoir. The most common fish in the McKenzie River is the cutthroat trout but the rainbow trout is the fish that has given the McKenzie River its reputation for fine angling.

The McKenzie River is one of the heaviest stocked rivers in Oregon. Rainbow trout are the fish of choice for Oregon Department of Fish and Wildlife's (ODFW) stocking program in the McKenzie River (ODFW, 1988). Stocking the main stem and South Fork of the McKenzie River and Blue River with 145,000 legal size rainbow trout paid for by the ACOE occurs annually. The ACOE funds this stocking effort to compensate for lost habitat due to the dams built in the Willamette River system. The ODFW also stocks Trail Bridge, Carmen Smith, and Leaburg reservoirs with an annual average of 110,000 fish, bringing the total annual stocking in the watershed to about 250,000 fish. These fish are reared at the Leaburg Trout Hatchery.

Bull trout (commonly called Dolly Varden) are the native char in the McKenzie River and are the only char native to the state of Oregon. The bull trout (the aquatic equivalent of the wolf) is a top predator in the river. Oregon is at the southern edge of the bull trout range and the McKenzie bull trout are the only population of note remaining west of the Oregon Cascades. They are a cold water fish leftover from the ice age and are a very small population generally found in the upper stretches of the McKenzie River above Leaburg Dam, and in Horse Creek and the South Fork McKenzie River, above and below Cougar Reservoir. (see Chapter 3, Stream Habitat for more detail).

Spring chinook salmon are native to the McKenzie watershed and are the largest common fish in the river. Historically, spring chinook spawning and rearing areas were distributed along the mainstem

McKenzie up to Tamolitch Falls, Gate Creek, Horse Creek, Lost Creek, the South Fork McKenzie, Blue River, and the Mohawk. However, with dams affecting fish passage and temperature, the run has been reduced from historic levels. Temperature changes have delayed adult fish migration and decreased fry survival.

There are also concerns with the effects the hatchery fish are having on the native run. Composition of the spring chinook run has shifted from a wild-production run of the late 1950s to a present run heavily supported by hatchery fish produced at the McKenzie Hatchery. The ability of the McKenzie River spring chinook population to be self-sustaining is a controversial issue. High quality habitat in the McKenzie River may provide the only area in the Willamette Basin as a whole where spring chinook are capable of self-sustaining the population. (For more detailed information, see Chapter 3, Stream Habitat section).

Other anadromous fish (fall chinook, coho, and steelhead) are not native to the Willamette Basin above Willamette Falls, but have been introduced to the basin over the years. Summer steelhead are known to compete with the rainbow trout for spawning areas. There is also antagonism between anglers who fish for steelhead and those who fish for rainbow trout. The ODFW made a decision to limit release of summer steelhead smolts to below Leaburg Dam. There are still 500 to 1000 steelhead that make it over the dam each year.

The McKenzie watershed also supports a number of other species. Mountain whitefish are native and found throughout the McKenzie River and its largest tributaries. Other native species include the Oregon chub, lampreys, minnows, sculpins, threespine stickleback, and white sturgeon. The Oregon chub is thought to be found generally in the lower McKenzie watershed and is listed as a threatened species by the United States Fish and Wildlife Service. Non-native warm-water fish found in the McKenzie watershed include largemouth bass, bluegill, and crappie.

C. Vegetation and Wildlife Habitat

Forest lands make up approximately three-quarters of the land base in the McKenzie watershed (Gregory et al., 1992). Vegetation in these areas include Douglas fir, true firs, western and mountain hemlock, western redcedar and incense cedar and Port Orford cedar, big leaf and vine maples, salmonberry, and salal. Typically, Douglas fir, western hemlock, and western red cedar are found at lower elevations and are the primary tree species up to about 3,500 feet. Above this elevation, Pacific silver fir and noble fir are the transition tree species with subalpine fir, lodgepole pine, and mountain hemlock becoming the dominant timber types above 4,500 feet. In the cold air drainage pockets associated with the gentle topography of the High Cascades, small stands of Engelmann spruce are found, usually at elevations above 3,000 feet. Big game species associated with forest habitat include black-tailed deer, Roosevelt elk, black bear, and mountain lion. Upland game species include the blue and ruffled grouse, mountain quail, and bandtailed pigeon.

Grasslands are primarily located within forest zones and generally occur as natural openings, such as meadows. These areas are important for elk, deer, grouse, turkey, mountain quail, gophers, ground squirrels, hawks, owls, and many smaller forms of wildlife.

Agricultural lands in the watershed provide important upland game and waterfowl habitat. Many species of song birds, small and large mammals, hawks, and owls are dependent upon this habitat type. Black-tailed deer may also be found using these areas as long as adjacent land types are available for cover.

Wildlife habitats in the McKenzie watershed have been significantly disturbed through time, especially along the riparian section from Cougar Dam down to the confluence of the Willamette River. It is estimated that more than 80 percent of the riverine forest and floodplain has been altered by human activity in the watershed. Only 8 percent of the length of the mainstem of the McKenzie includes mature to old-growth forest along both banks of the river, and almost all of that is in the upper river reach above Lost Creek (Gregory et. al., 1992).

Alterations of floodplains and riverine forests have been most pronounced in the lower river where private land owners control the majority of the riparian lands (Gregory et al, 1992). These riparian areas are considered very important for wildlife habitat and are considered a concentration point for a variety of species, affording them food and protection. Beaver, muskrat, otter, mink, raccoon, and pine marten, which inhabit riparian areas, are the principal furbearers in the watershed.

IV. Land Use and Ownership

A. Historical Background and Settlement History

The early nineteenth century historic period is poorly documented. However, it is known that four aboriginal peoples (the Kalapuya, Molalla, Tenio, and Northern Paiute) frequented the areas within or near the watershed at the time when settlers from Europe began to explore the region (Willamette N.F., 1994).

Native Americans were known to traverse the mountains and valleys of the McKenzie area. The Warm Springs tribe of north-central Oregon made annual crossings over the Cascades into the McKenzie Valley to catch and smoke salmon and eels. These yearly migrations continued into the twentieth century and early observers describe large encampments, with large areas devoted to drying fish. The Indians traded with settlers, and in later years, when game became scarce, they worked in hops yards on farms in the area.

Donald Mackenzie (note spelling), an early-day explorer with the John Jacob Astor Pacific Fur Company, headed a small party of men who explored the Willamette Valley in 1812. They later named one of their discoveries Mackenzie's Fork of the Willamette River, which during pioneer days was shortened to Mackenzie Fork. The name is now universally McKenzie River.

The Land Donation Act of 1850 played a major role in attracting early settlers to the lower McKenzie valley where they discovered deep, fertile soils and filed for Donation Land Claims that allowed each person 320 acres. Most bottomlands from the confluence of the McKenzie and Willamette Rivers to Walterville were settled in this way and generations of burning on the valley floor by the Kalapuya and Mollala Indians made pioneer settlement of the lower valley relatively easy. The Homestead Act of 1862 and the coming of the Oregon and California (O & C) Railroad in 1872 brought additional pioneer settlement to the valley (Committee for the Economic Development of the McKenzie River Valley, 1986).

In the 1860s and '70s, isolated homestead settlements emerged along the wider river benches on the north bank of the McKenzie River in the upper river corridor. These settlements were connected by the McKenzie Wagon Road, built in the 1860s as one of two major routes to eastern Oregon from Lane County. Gold deposits on Blue River and the hot springs on the McKenzie and Horse Creek were discovered in the 1860s, but it was not until the 1890s that development surrounding these activities began to have substantial impact on the cultural landscape (Forster, et al., 1986).

Oregon's first trout hatchery was built about 1904 near Leaburg Dam. The original hatchery was deeded to Lane County in 1952 when it was replaced by a newer trout hatchery built in another location. The restored original hatchery facility is scheduled to become an educational center.

Until 1913, loggers on the McKenzie used the river to transport log rafts. The McKenzie River Valley was the only major river valley in Lane County that did not have a railroad built for logging purposes. Until the end of the river drives, harvested logs were floated in rafts to the mills at Coburg, Springfield, and mills further down the Willamette River. Perhaps because of the absence of rail transport, truck transportation developed earlier in the upper McKenzie Valley than in other areas of the county. By the 1930s, there were 12 small mills along the McKenzie River. By the 1940s, the pattern of trucking logs out of the valley to mills in Springfield and Eugene began to displace local milling activity (Forster, et al., 1986).

Logging in the Mohawk River Valley evolved differently. Small saw mills existed in the lower Mohawk Valley since 1850s, but those mills primarily served local lumber demands. The entry of the Booth Kelly Lumber Company and their railroad transformed the valley floor from the agrarian landscape to an industrial landscape by the end of the nineteenth century. Hundreds of laborers settled in the Mohawk Valley. Between 1848 and 1945, there were at least 16 mills operated by seven lumber companies. The mills were strategically located throughout the Mohawk Valley where creeks joined the river. Splash dams, flumes, ditches, pole roads, and log ponds were built to serve the mills. By 1910 the valley floor at Marcola, Wendling, and Mabel resembled a huge outdoor factory. Eventually, hundreds of miles of track were laid in the mountains above the valley. However ,in the 1950s, with the decline of local lumber firms, the lumber mill era ended in the valley and the mills moved into Springfield (Forster, et al.).

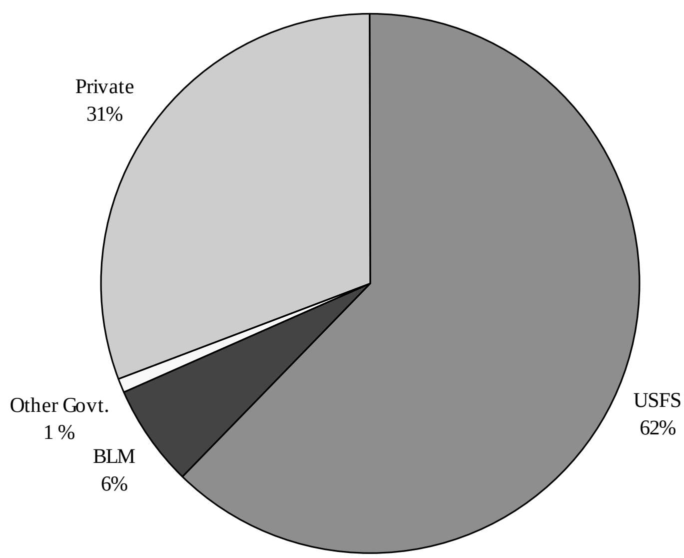
Completion of water diversion canals (Eugene Water & Electric Board Walterville and Leaburg power canals) and improvement of the road along the river as a state highway brought new small farm and residential development to the McKenzie Valley between Walterville and Vida (Forster, et al., 1986). Today, development along the river and transportation corridors continues to grow, especially in and near the urban portions of the watershed.

B. Land Ownership

Map 6 (page 27) and *Figure 1* depict land ownership in the McKenzie watershed. Approximately 69 percent of the watershed is under public ownership, with the Willamette National Forest being the largest single land manager, comprising about 62 percent of the watershed's acreage. The BLM holds about 6 percent of the watershed's area with state, county, municipal, and other federal ownership comprising less than 1 percent.

Timber companies as a group are the largest private land owners in the watershed. Weyerhaeuser Company is the largest private landowner, but several other timber companies also have large holdings (Rosboro Lumber Company, Giustina Land and Timber Company, Giustina Resources, John Hancock Company, and Willamette Industries).

Figure 1
Land Ownership in the McKenzie Watershed



C. Land Use

Map 7 (page 29) displays general zoning for the McKenzie watershed. Forestry is the predominant land use in the watershed, with agriculture and rural and urban development essentially confined to the valleys. Urban uses predominate within the Eugene-Springfield metropolitan portion of the watershed. Land use in this area is guided by the Eugene-Springfield Metropolitan Plan.

Soils in the McKenzie watershed support some of the most productive forests in the region. Species of common trees in the watershed include Douglas fir, grand fir, western hemlock, western red cedar, noble fir, mountain hemlock, and lodgepole pine. Much of the public forest is reserved from timber harvesting and new management plans are being developed to address ecosystem management. The Oregon Forest Practices Act and its regulations provide the framework for timber management on private forest lands.

Nearly 4 percent of the watershed is classified as being suited for cultivation, with most of these lands being found near the mouth of the McKenzie River and some lying along the Mohawk River and Camp Creek (State Water Resources Board, 1961). Some of the most productive agricultural lands are located in the McKenzie delta area, an area within the Eugene-Springfield Urban Growth Boundary, which is planned for development and which is being rapidly developed.

In terms of monetary value, the OSU Extension Service estimates that the McKenzie watershed makes up approximately one-fifth of Lane County's agricultural production. Filberts are the most extensive agricultural crop in the watershed, covering approximately 1,200 acres. Other crops in the watershed include blueberries, pumpkins, green beans, corn, carrots, mint, and grass seed. Cattle and pasture lands are prevalent on the Mohawk tributary.

Other small private land holdings occur in the lower valley, many of which are found adjacent to the McKenzie and Mohawk Rivers and along Camp Creek. Often these parcels occur in a band one parcel wide, or in clusters of rural communities. The Lane Rural Comprehensive Plan identifies eight rural communities within the McKenzie watershed. The communities of Walterville, Leaburg, Vida, Nimrod, Blue River, Rainbow, and McKenzie Bridge are located along the McKenzie River, while Marcola lies along the Mohawk River. Historically, these rural communities developed in conjunction with a forest related industry, such as a lumber mill. Today, these communities are essentially made up of small private ownership with some commercial development. Many of these communities also contain some publicly designated land for government operations or parks.

Major sand and gravel operations are located near the confluence with the Willamette River in the metropolitan area. There are also a number of rock quarries located on the Blue River and McKenzie River Ranger Districts, but with major reductions in logging and road building/reconstruction these quarries currently receive little or no use. In the past, gold and silver have been mined in the Gold Hill area north of Blue River.

The McKenzie watershed and its river corridor have received regional and national recognition for their remarkable scenic beauty and outstanding recreational opportunities. The watershed includes approximately 225,000 acres of designated Wilderness and the 26-mile-long McKenzie River Trail, a National Recreation Trail.

Both state and federal programs have designated portions of the McKenzie River as scenic. In 1988, a 12.7-mile stretch of the McKenzie River from Clear Lake to Scott Creek was designated as a National Wild and Scenic River, omitting the existing hydroelectric developments. Under the Wild and Scenic Rivers Act, a river may be classified as wild, scenic, or recreational. The McKenzie River is classified as a recreational river. Portions of the upper McKenzie River received additional recognition through the Oregon Rivers Initiative of 1988 which designated 15.8 miles of the McKenzie River as an Oregon Scenic Waterway. The state designation includes the portion of the McKenzie River from Clear Lake to Paradise Campground, omitting the stretch from Carmen Reservoir to Tamolitch Falls and hydroelectric developments. Also, two stretches of the South Fork McKenzie River, one above Cougar Reservoir and the other below the dam, have received Oregon Scenic Waterway designations.

In addition, two National Scenic By-ways are found in the watershed. Just east of the community of Blue River is Aufderheide Drive (Forest Service Road 19) and five miles east of McKenzie Bridge is the Old McKenzie Pass Highway 242.

Forty-three recreational facilities draw visitors to the watershed (four Lane County parks, five state parks, one EWEB park, one BLM park, and 24 U.S. Forest Service campgrounds. Hoodoo Ski Bowl and eight sno parks provide for winter recreation. Private lodges, resorts, and cabins offer accommodations to visitors.

V. Demographics

Map 8 (page 31) displays the distribution of urban and rural residences in the McKenzie watershed. Approximately 22,648 people were living in the McKenzie watershed according to the 1990 U.S. Census. Roughly 58 percent (13,136) lived in the urban portions of the watershed (Eugene/Springfield), while the remaining 42 percent (9,514) resided in rural areas.

During the 1980s, the number of households in the rural area increased by 5 percent from 3,430 to 3,595, while household size became smaller. The number of households in the urban portion of the watershed increased by about 13 percent from 4,193 to 4,751 (U.S. Census, 1990).

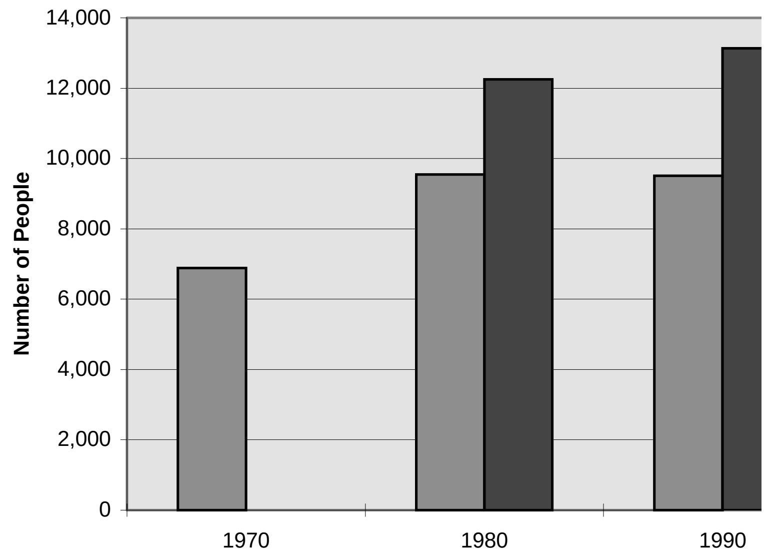
Figure 2 provides the occupational breakdown of McKenzie area residents in 1990. White collar, service, and manufacturing/retail/wholesale made up approximately 70 percent of all occupations held by McKenzie area residents in 1990. Between 1980 and 1990, farming and forestry occupations dropped from 4 percent to 3 percent, while technical, professional, executive, machine operator, and material moving increased (U.S. Census, 1990).

Figure 2
Major Employment Categories in the McKenzie Watershed

Source: U.S. Census Bureau

Population trends in the rural parts of the watershed reflect the shift in jobs and opportunities over the last 20 years. *Figure 3* displays population changes in the watershed from 1970 to 1990. Between 1970 and 1980 the number of people living in the rural area increased 38.6 percent (U.S. Census, 1980). By 1990, the population in rural areas of the watershed had dropped slightly (-0.4 percent). These population shifts were not evenly distributed throughout the watershed. During the 1980s the number of people living in the Mohawk Valley actually increased by almost 10 percent, while the rest of the rural area declined by 8.4 percent (U.S. Census, 1990).

Figure 3
Population Change in Rural and Urban Areas of the McKenzie Watershed



Source: U.S. Census Bureau (Urban population data not available for 1970)

Map 6. Land Ownership

Map 7. General Zoning

Map 8. McKenzie Watershed Development

Chapter Three

Existing Conditions for Water Quality and Fish and Wildlife Habitat

I. Introduction

This chapter presents existing conditions for water quality and fish and wildlife habitat in the McKenzie watershed. Water quality and fish and wildlife habitat conditions have been divided into five main categories corresponding to the five related action plan goals of the McKenzie watershed Council. The categories were selected to address the various aspects of water quality and fish and wildlife habitat. In reality, these aspects are tightly interconnected and dependent upon one another. This chapter provides the background information and analysis from which the goals objectives and priority actions were generated. The five priority goals and parallel chapter sections include:

1. **Water Quality** - The McKenzie Watershed Council's Water Quality goal is to: *maintain and enhance existing high water quality of the McKenzie River, tributaries, and underlying groundwater for drinking water, fish and wildlife habitat, water contact recreation, industry and aesthetics*. A comprehensive evaluation of water quality within the McKenzie River watershed is limited since there are gaps in water quality data. Data that do exist indicate that within the Willamette River basin as a whole, the McKenzie River's water quality is relatively high. However, there are areas showing potential water quality problems.

2. **Water Quantity** - The council's Water Quantity goal is to: *ensure adequate streamflow exists in the McKenzie River and tributaries to meet instream and out-of-stream water needs (e.g., aquatic habitat, recreation, pollution dilution, irrigation, industry, hydroelectric power, etc.).* Water quantity varies from the McKenzie's headwaters to its confluence with the Willamette River. Natural flow patterns that historically pulsated depending on precipitation input and snow melt, have been altered by dams, diversions, changes in vegetation, and permitted withdrawals. Hydropower and irrigation account for the majority of water rights that have been issued for the McKenzie and its tributaries. In several areas of the watershed, there is water availability allowing additional water rights to be issued for distinct purposes and specific times of the year.

3. **Riparian Areas and Floodplains** - The council's Riparian Areas and Floodplains goal is: *emphasizing the voluntary cooperation of private landowners and public land managers, maintain and/or restore the functions of healthy riparian areas and floodplains because of the importance of those areas to watersheds and stream conditions*. Riparian areas provide important functions related to water quality, water quantity, and fish and wildlife habitat. Although a complete watershed assessment of riparian conditions has not been conducted, it is evident that riparian quantity, quality, and connectivity in the watershed has decreased from historical levels. Federal, state, and local regulations provide the legal framework to protect further degradation and in some cases recovery of this resource area. Voluntary restoration, enhancement, and conservation opportunities exist in many places throughout the watershed.

4. **Stream Habitat** - *Improving stream habitat to maintain/increase fish populations and other aquatic life* is the Stream Habitat goal of the McKenzie Watershed Council. Like other categories addressing the various aspects of water quality and fish and wildlife habitat, a complete assessment of stream habitat has not been completed for the McKenzie watershed. Native fish populations, such as the spring chinook and bull trout, have declined from historic levels. Influences on fish habitat and survival include: water temperature, fine sediments, amount and quality of spawning areas, large woody debris, course gravels, and number of pools. Natural conditions of these factors have been altered by disturbances such as, dams, logging, road construction, and development.

5. **Uplands** - The Council's Uplands goal is to: *maintain healthy, sustainable uplands and special habitats throughout the watershed to protect and enhance water quality and fish and wildlife habitat*. About 329 wildlife species are found in the McKenzie watershed and most of these species depend on upland habitat. Upland areas also influence the quantity and quality of water entering waterways. Satellite imagery has provided data on vegetation seral stages for the watershed. Seral stages range from early seral, found more frequently in the lower watershed, to some late seral, found more often in the upper McKenzie areas. The natural pattern and composition of forest has been altered significantly by human activities.

II. Water Quality

The McKenzie watershed is the source of drinking water, both surface and groundwater, to over 200,000 Lane County residents. Major industries count on the water supply to be free of impurities that could harm their products. Kayaking, rafting, and drift boat fishing are among the popular water contact recreation uses of the river. Fish are dependent on high water quality for passage, spawning, rearing, and overall viability. Oregon has adopted standards to protect these varied and beneficial uses of water.

A. Data Inventory

In May 1994, the council assembled a *Water Quality Task Group* (See Appendix A) made up of technical advisors from academia and industry and federal, state and local natural resource agencies. Among its responsibilities was the charge to provide a comprehensive evaluation of current water quality data, including identification of baseline conditions, trends, data gaps, and problem areas. Early on, the technical advisors recognized that although several agencies have collected water quality data over time, no one had analyzed the data to determine baseline conditions for the entire McKenzie.

With the Council's concurrence, the U.S. Geological Survey (USGS) was contracted to inventory surface-water quality data for the McKenzie watershed with the expectation that sufficient data existed to describe current water quality conditions watershed-wide. The resulting inventory found that considerable data gaps prevent any meaningful baseline watershed-wide water quality assessment. In light of these findings, the USGS recommends waiting to analyze existing data concluding that "a much better and more cost effective analysis could be made if these historic data were analyzed along with data collected in a new monitoring network."

The USGS was only contracted to inventory surface water quality data, reflecting the Water Quality Task Group's initial surface water focus. Technical advisors were very conscious of the arbitrary distinction between surface and groundwater, but recognized the need to begin the process somewhere. The technical advisors intend to revisit groundwater quality issues once work on surface water is well underway. Indications are that there is significant discharge of groundwater into the McKenzie River which could have a significant effect on water quality for the River.

B. Water-Quality Trends

The *Willamette River Basin Water Quality Study* (August 1995) prepared for the Oregon Department of Environmental Quality (DEQ), examined the Willamette River Basin including portions of the McKenzie River. The study reported that water quality in the lower reaches of the McKenzie River as a whole had the highest water quality conditions compared to other areas in the Willamette River Basin. The upper reaches of the McKenzie River were not evaluated in this study. Although water quality in the lower McKenzie is considered good, it still occasionally violates water quality standards. Logging, urban development along the river corridor, road building, and agricultural uses are considered the major non-point pollution sources within the watershed.

DEQ is responsible for assessing surface waters relative to state water-quality standards. DEQ performed a trends analysis of the limited data collected at its Coburg Road site located approximately seven miles above the McKenzie River's confluence with the Willamette River. This site is part of DEQ's fixed station monitoring network used to determine if water quality in the McKenzie meets state standards. Oregon's 1994 Water Quality Status Assessment Report, the 305(b) Report, identified the lower reaches of the McKenzie River as being water quality limited due to violation of the state's dissolved oxygen (DO) standard during the fall, winter and spring periods. This limitation affects aquatic life in the river since nearly all aquatic animals require the presence of some oxygen in the water, with cold water fishes (salmonids) requiring high levels.

Pollution sources, such as failing septic systems, can lower DO levels by introducing oxygen-demanding materials or by stimulating growth of bacteria and other oxygen consuming micro-organisms. DO levels may depend on water temperature and may indicate lack of adequate riparian shading influencing DO during the late spring and early fall. Lack of riparian shading would probably not influence DO during the winter months.

It is important to note that DEQ is proposing changes to the state's DO standard. Proposed modifications, based on concentration rather than saturation, provide a more direct measure of the effects of DO on beneficial uses without measurably impairing the level of protection. The main reasons DEQ cites for needing these changes are:

1. Some of Oregon's DO criteria are expressed as saturation, while others are expressed as concentration. Concentration criteria better represent the needs of fish than saturation criteria.

2. DO concentration needed to protect salmon, trout, or other species is the same statewide,

whereas the present criteria are not.

3. Present standards do not provide a direct measure of the oxygen needed to protect juvenile salmon in the gravel redds.

DEQ recommends that DO criteria be identified as concentration, rather than saturation, to better reflect the needs of aquatic resources and reduce the number of streams that violate water quality criteria due to natural conditions. DEQ also proposes an intergravel DO standard.

A limited water-quality assessment has been performed for the lower reaches of the McKenzie River. A 1995 DEQ analysis (*Trending Analysis for the Clackamas, North Santiam, and McKenzie Rivers)* observed several trends that are summarized in *Table 2*. However, these trends appear to be related to releases from reservoirs, the time of day samples were collected, or changes in sampling procedure. Existing data suggest that water quality in the lower McKenzie River is sensitive to conditions that typically vary throughout the day (diurnal variation for oxygen, pH, and temperature). This type of variation could lead to decreased aquatic habitat conditions and the violation of certain state water quality standards during certain times of the day.

Table 2
Trending Analysis Summary
McKenzie River at Coburg Road
(River Mile 7.1)

Parameter	Interval	Trend*	Step Year	Significance Level	Months	Reported	Comment
NO_2	’80-’94	- Step	’87/’88	95%	June- Sept.	True	No gradual trends found following step
PO_4	’87-’94	¯ Gradual	N/A	95%	June- Sept.	True	
Dissolved Oxygen	’76-’94	- Step	’87/’88	99%	June- Sept.	Apparent	Trend caused by change in sampling time
Dissolved Oxygen	’87-’94	¯ Gradual	N/A	99%	All Seasons	Apparent	Trend caused by change in sampling time
D.O. % Saturation	’75-’94	- Step	’87/’88	99%	June- Sept.	Apparent	Trend caused by change in sampling time
$B.O.D._5$	’75-’94	- Step	’86/’87	99%	June- Sept.	Apparent	Trend may be caused by change in lab procedure
Conductivity	’80-’94	- Step	’87/’88	95%	June- Sept.	True	No gradual trends found following step
Total Solids	’80-94	- Step	’87/’88	99%	June- Sept.	True	No gradual trends found following step
T. Suspended Solids	’80-’94	- Step	’87/’88	95%	June- Sept.	True	No gradual trends found following step
pH	’80-’94	- Step	’82/’83	99%	June- Sept.	Apparent	Trend may be caused by change in lab procedure
pH	’84-’94	- Gradual	N/A	90%	June- Sept.	Apparent	Trend less than 80% when adjusted for time
Flow	’80-’94	¯ Step	’87/’88	80%	June- Sept.	True	

**Gradual trends* show a gradual change over time. An example of a *gradual trend* would be increased development resulting in increased nonpoint source loads. *Step trends* show a sudden change and should be evaluated in relationship to activities that may have caused a sudden shift in water quality, or change in reported water quality conditions. *Step trends* can be associated with a major pollution source or a change in analytical procedure that leads to a sudden change in reported water quality without an actual change in instream conditions.

Source: Oregon Department of Environmental Quality, February 1995

C. Toxic Substances

Toxics data for the McKenzie River are limited and do not support a trending analysis. Available DEQ fish tissue data indicate that certain toxic compounds are potentially present in the lower McKenzie River. DEQ concludes that fish tissue data are probably influenced by urban and major industrial runoff. No state fish tissue standards exist, but some toxics are occasionally observed in fish tissue that are above Environmental Protection Agency *fish tissue evaluation values*. Based on the limited data, the parameters of Arsenic, PCB, Alderin, DDT, and its metabolites are occasionally observed in fish tissue above EPA evaluation values. No violations of the Food and Drug Administration *action levels* were observed. The EPA and FDA criteria are often substantially different. The Oregon Health Division has not indicated that a fish advisory for the McKenzie is necessary. Water column toxics data indicate the presence of some toxics, however, observed values are limited.

DEQ water column toxics data are available for the lower river, but observed values are limited and do not allow for comparison in other river locations. *Table 3* provides a summary of some of the toxic substances found at the Coburg Road and Hayden Bridge monitoring sites. *Table 3* also compares the observed values to the standards identified in Oregon Administrative Rules (OAR) 340-41-Exhibits, *Table 20*. The EPA and DEQ recommend that dissolved metals, rather than total recoverable, be compared to criteria for ambient data since dissolved metals better reflect the proportion of the metal that may bio-accumulate.

Both DEQ sites, listed in *Table 3*, had toxic criteria infractions, but these violations should be interpreted with caution. The observed toxics data do not meet DEQ requirements for adequate number of data, or frequency of criterion exceedance to be identified as being water quality limited. For example, at Hayden Bridge, 78 percent of the reported dissolved zinc values were below detection levels. Of the values greater than detection, the mean approximated the criterion values for aquatic life as adjusted for hardness, and the maximum values exceeded criterion values.

Table 3
McKenzie River Toxic Data Summary (*ug/l*)
For Parameters with Values Above Detection Levels at
Department of Environmental Quality Sites

Site Location	**Parameter**	**Number Below Reported Value**[1]	**Observed Values**				**Criteria**[2]
			N	**Min.**	**Max.**	**Mean**	
McKenzie @ Coburg	Cadmium (total)	7	1	**6**	**6**	**6.0**	0.28[3] (A)
	Copper (total)	6	2	**3**	**6**	**4.5**	2.67[3] (A)
	Iron (total)	2	16	50	**2770**	282.5	300 (H)
	Iron (dissolved)	9	12	40	139	69.75	300 (H)
	Manganese (Mn)	9	9	10	**70**	22.2	50 (H)
	Manganese (dissolved)	12	9	.01	40	12.2	50 (H)
	Zinc (dissolved)	5	1	10	10	10	24.2[3] (A)
	Zinc (total)	6	2	**60**	**140**	**100**	24.2[3] (A)
McKenzie @ Hayden Br.	Iron (total)	3	4	40	100	60	300 (H)
	Iron (dissolved)	3	4	40	100	60	300 (H)
	Zinc (dissolved)	28	8	10	**70**	**25**	24.2[3] (A)
	Zinc (total)	1	1	**100**	**100**	**100**	24.2[3] (A)

Source: Oregon Department of Environmental Quality, February 1995

Notes:
1. Actual value is known to be less than reported value
2. H = protection of human health criteria; A = protection of aquatic life criteria
3. Corrected for hardness

Numbers in bold indicate criteria violations. Violations should be interpreted with caution since observed toxic data do not meet DEQ requirements for adequate number of data or frequency of criterion exceedance to be identified as being water quality limited.

III. Water Quantity

Adequate streamflow supports the health of aquatic and riparian habitats, improves water quality by lowering pollution concentration levels, and maintains recreational values. Water depth, flow patterns, and duration and frequency of flooding within riparian zones are major factors affecting plants and wildlife. Riparian areas subsequently influence water quality and the health of the aquatic system. In addition, adequate streamflows can ensure that sufficient water is available for hydro-electric power generation, industrial, agricultural, and municipal purposes.

A. Flow Patterns

Streamflows in the McKenzie River approximate seasonal rainfall and snowmelt patterns, with peaks usually in February and May and low flows from August through October. It appears that a significant volume of groundwater discharges into the lower reaches of the McKenzie, since flows are 20 percent higher near the confluence of the Willamette than would be expected solely from overland sources. Natural flows are generally not stable, but fluctuate seasonally according to precipitation. Near the Willamette confluence, flows range from a high of about 10,200 cubic feet per second (cfs) to low flows of 2,020 cfs.

Natural flow patterns in the McKenzie have been altered substantially by dams, diversions, water withdrawals, and development. Periodic high flows are important to maintenance of unvegetated gravel bars and alteration of channel bedforms, a naturally occurring process that improves channel complexity, and vegetation, fish, and wildlife heterogeneity. Construction of dams on the mainstem McKenzie and two major tributaries, Blue River and the South Fork, has altered the flow regime and sediment supply to the mainstem. This flow alteration has decreased the frequency, mean, and variation of peak flows, reducing the ability of flows to move bedload, and cutting off sediment from over half of the drainage area. Since the construction of dams within the McKenzie system, mean peak flows decreased 44 percent. In addition, the competence of peak flows (with a 2-year recurrence interval) to move bedload, declined approximately 29 percent after dams were constructed (Minear, 1994).

The McKenzie River is diverted by the Eugene Water & Electric Board for power generation purposes at two locations. The Leaburg canal at river mile 24 near Leaburg Dam diverts part of the McKenzie River for five miles to the Leaburg Powerhouse. Water diverted at the dam passes through a downstream migrant fish screen before entering the canal and water is returned to the McKenzie River through a 1,100-foot-long tailrace. Another diversion is located at river mile 15 at the Walterville Landing. The Walterville canal diverts part of the river for four miles to the Walterville Powerhouse. Water is returned to the river through a 2-mile-long tailrace canal, part of which is an old river meander channel.

Figure 4 presents average annual flows recorded at U.S. Geological Survey (USGS) gauging stations along the McKenzie and tributaries. Flows expand from 454 cfs at the McKenzie headwaters at the Clear Lake outlet to an average annual discharge rate of 5,809 cfs near its confluence with the Willamette at Armitage Park. Dams and diversions change the flow along the river. The average annual withdrawal/return at Leaburg and Walterville Canals decreases and increases the flow in the McKenzie by about 50 percent. Releases from Cougar and Blue

River Dams have also altered flows on the mainstem McKenzie. Combined effects from water released from these reservoirs represent flow increases of 30 to 50 percent during summer and corresponding decreases in late winter and spring.

Figure 4
Schematic Diagram Showing Drainage Area and
Average Discharge at USGS Gauging Stations in the McKenzie Watershed

Source: United States Geological Survey, June 1995

B. Existing Water Uses and Water Rights

Under Oregon law, all water is publicly owned and users (with some exceptions) must obtain a permit or water right to use water sources. Oregon's water laws are based on the principle of prior appropriation. The first person to obtain a water right on a stream is the last to be "shut off" in times of low streamflows. Generally, state law does not provide a preference for one kind of use over another. If a conflict between users emerges, the date of priority determines who may use the available water. If the water rights in conflict have the same priority date, domestic use and livestock watering have preference over other uses.

All waters within the state may be appropriated for use except those that are withdrawn by legislative action or restricted by an administrative order of the Water Resources Commission, a seven-member citizen body that sets water policy. The commission cannot adopt water-use restrictions that reduce existing water rights, but may modify or add new restrictions that affect new uses. The commission also sets minimum streamflows and approves instream water rights; this is for fish protection, to minimize the effects of pollution, or to maintain recreational uses. State law declares public uses, including fish and wildlife, water quality and recreation, to be beneficial uses and establishes the legal status and procedure for issuing instream water rights for public uses. Oregon Departments of Fish and Wildlife, Environmental Quality, and Parks and Recreation can apply for instream rights. Minimum streamflows and instream water rights, like all rights, have a priority date and cannot affect a use of water with a senior priority date.

Presently, ten stream reaches in the watershed have instream water rights or minimum flows (*Map 9* (page 47)). These rights total 3,131 to 3,385 cfs, depending on the time of the year. Additionally, four of these reaches have a minimum stream flow for releases from stored water in the total amount of 1,860 cfs.

Table 4 summarizes non-instream water rights for the McKenzie watershed. Aside from instream water rights, there are approximately 10,962 cfs of surface rights and 242,571 acre feet of reservoir rights allocated in the McKenzie watershed. Hydropower accounts for 91 percent of the surface water and about 7 percent of the stored water allocations. Hydropower does not consume water, but in several cases removes it from long reaches of the river. Conversely, water rights for irrigation account for only 2.5 percent of the appropriated surface water and 92 percent of reservoir water. Less than 85 cfs of groundwater is allocated in the McKenzie watershed, with 63 percent of this earmarked for irrigation. Most of the remaining groundwater is appropriated for municipal use.

Table 4
Summary of Non-Instream Water Rights for the McKenzie Watershed

Use	Surface Water Rights		Groundwater Rights		Reservoir Rights	
	cfs	No. of WRs	Cfs	No. of WRs	Acre/Feet	No. of WRs
Irrigation	279.15	406	51.79	137	223,023.20	14
Domestic	6.41	164	0.96	4	0.00	0
Municipal	304.80	4	26.90	18	0.00	0
Power	9,983.39	13	0.00	0	17,645.00	5
Industrial	94.9	13	2.19	5	848.10	5
Fish & Wildlife	291.75	24	0	0	42.70	10
Other	1.50	22	0.45	3	1011.98	5
Total	10,961.90	646	82.29	167	242,570.98	39

Source: Oregon Water Resources Department, October 1994

C. Potential New Water Appropriations

Water availability is a major factor in the determination of whether new water rights are granted. The Oregon Water Resources Department determines whether new appropriations will be allowed. Water availability is a major factor in these determinations. Currently, water appropriations are still available in the McKenzie watershed for certain uses and periods of the year.

Maps 10 through 14 (pages 49, 51, 53, 55, 57) illustrate by month where new water appropriations (water rights) are available throughout the McKenzie watershed. During the winter months of December and January, and spring and early summer months, water is available throughout most of the watershed. The exception is a small area in the upper McKenzie. During February, water is available throughout the watershed except in the Blue River sub-watershed. Towards the end of the summer months, in August, water availability begins to diminish when water rights are not available in Gate Creek and Blue River watersheds. During the lowest flow period of the year, September and October, the largest area is excluded from water availability. Gate Creek, Blue River, White Branch, and Horse Creek sub-watersheds are not available for new water rights during these two months.

A general overview of surface water classifications for water rights in the watershed is provided in *Table 5* and *Map 15* (page 59). Surface water classifications designate the type of new water right applications that may be considered. For instance, in the mainstem McKenzie River downstream from Paradise Campground, new irrigation uses are not allowed, however, other types of uses may be granted if water is available. *Map 15* is intended for use as a quick reference guide and should be used in tandem with *Table 5* and the *Willamette Basin Rules* (OAR 690, Division 502) to ensure that a proposed use of water is consistent with the provisions of these rules.

As is indicated in *Table 5*, all of the McKenzie watershed, with the exception of reservation water, is open to new applications for domestic, livestock, and public instream uses. Other than lakes above a 3,000 foot elevation, commercial use for customarily domestic purposes (not to exceed .01 cfs) will also be considered. The mainstem McKenzie downstream from Paradise campground, has the most opportunity for new water rights to be issued. This river area allows new water rights for uses such as: fish life, pollution abatement, wetland enhancement, and recreation. New water rights, other than domestic, livestock, commercial, and public instream will not be considered for three sub-basins in the McKenzie. These include: McKenzie River and tributaries above Paradise Campground, South Fork McKenzie River and tributaries, and Blue River and tributaries. All other tributaries only allow most new water right uses during October through June.

Table 5
Surface Water Classification Summary for Water Rights In the McKenzie Watershed

Uses

Sub-basin	**DO**	**LV**	**CD**	**PI**	**IR**	**MU**	**IM**	**AG**	**CO**	**PW**	**MI**	**FI**	**WI**	**RC**	**PA**	**WE**	**ST**	**Comments**
McKenzie River downstream from Paradise Campground	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	1	
McKenzie River and tributaries above Paradise Campground	X	X	X	X													1	
South Fork McKenzie River & tributaries	X	X	X	X													1	
Blue River and tributaries	X	X	X	X													1	
All other McKenzie River tributaries	X	X	X	X	2	2	2	2	2	2	2	2	2	2	2	2	1	¬ Except July- Sept.
Lakes located above 3,000 feet in elevation	3	X		X														
Reservation: 85,000 acre-feet of water released from storage					X													

Source: Oregon Water Resources Department, October 1994

An "X" or a number in the use columns indicates the type of uses that may be made of "live" or natural streamflow. If the use columns are blank, the stream reach or area was not classified for those types of uses and new appropriations are not allowed. The comments column describes additional conditions imposed by rule or statute.

<u>Use Key</u>

DO	Domestic	MU	Municipal	FI	Fish life
LV	Livestock	IM	Industrial/manufacturing	WI	Wildlife
CD	Commercial use for customarily domestic purposes not to exceed 0.01 cfs	AG	Agricultural	RC	Recreation
		CO	Commercial	PA	Pollution abatement
		PW	Power	WE	Wetland enhancement
		MI	Mining	ST	Storage
PI	Public instream	IR	Irrigation		

Notes:
1. Any use may be allowed from stored water. The period of use is not restricted by the limitations on the use of natural streamflow described in the comments column. The period of filling (storage season) is Nov. 1 - June 30 unless otherwise stated.
2. Use allowed except for the time period (months) listed in the comments column.
3. Use excludes irrigation of lawn and noncommercial garden.

Map 9,
Instream Water Rights and Minimum Flows

Map 10,
McKenzie Basin Water Availability for Jan/Mar/Apr/may/Jun/Jul/Dec

Map 11,
McKenzie Basin Water Availability for February

Map 12
McKenzie Basin Water Availability for August

Map 13
McKenzie Basin Water Availability for September/October

Map 14
McKenzie Basin Water Availability for November

Map 15
McKenzie Basin Surface Water Classifications

IV. Riparian Areas and Floodplains

Riparian areas are those areas along rivers, streams, lakes, ponds, and any other waterbody including wetlands. Riparian areas can be viewed as three dimensional zones of direct interaction between land and aquatic ecosystems. These zones extend upward into the canopy of the vegetation and outward to the extent of flooding. In the McKenzie watershed, much of the riparian area and flood-plain are in private ownership and these are the areas most commonly impacted by development and other human uses.

A. Riparian Area Functions

Riparian areas can vary greatly in size and types of vegetation. In general, a healthy riparian area is indicated by a diverse mix of vegetation to the water's edge. Trees in the riparian area include saplings to mature trees of both hardwood species, such as maple, alder, cottonwood, and conifers such as Douglas fir and cedar. Healthy areas may also contain a variety of native shrubs and grasses. Vegetation in the riparian area and floodplain perform many important functions. Several of these functions include water quality benefits, stream habitat and food production, wildlife habitat for breeding, foraging, resting, and dispersal. Vegetation in this area helps to improve and regulate water quality by helping to moderate temperatures through shading, filtering excess nutrients before they enter the waterbody, providing bank stabilization that reduces erosion, and helping to regulate and moderate surface flows down stream. Riparian areas and floodplains reduce downstream flooding impacts by intercepting and slowing high flows.

The riparian area and floodplain provide an important link between upland and aquatic ecosystems. The link to the stream channel is so prevalent that changes in the riparian area can be translated rapidly into changes in stream biology. Bankside trees are the principle source of large wood material in streams. Fallen trees (large woody debris) in a stream form pools providing habitat essential for fish spawning and survival, and trap organic matter, a major food supply for macroinvertebrates, which are the base of the food web. In addition to these water quality and stream benefits, most birds and animals use riparian areas for some portion of their life history. These areas provide important travel corridors, food and resting sites, and places to breed and nest for numerous wildlife species.

B. Assessment of Conditions

Assessments were conducted by the U.S. Forest Service in the South Fork McKenzie watershed and upper McKenzie and by the Bureau of Land Management in the Mohawk watershed and along the north side of the McKenzie River near Vida. Weyerhaeuser Company conducted assessments in the Mohawk watershed and along parts of the lower McKenzie River area. A historical evaluation of riparian conditions was conducted by an Oregon State University graduate student for the mainstem McKenzie from Trail Bridge Reservoir to Leaburg Dam. A detailed assessment of riparian and floodplain conditions has not been conducted for the entire McKenzie watershed at this time.

Based on the results of completed assessments in various areas of the watershed, in general the quality, quantity, and connectivity of riparian vegetation along waterbodies within the McKenzie watershed has decreased over time. Logging, residential development, and agricultural clearing have all impacted riparian vegetation within the McKenzie watershed. The mainstem McKenzie has harvest units, roads, and recreation sites located within 9 percent of the riparian area. Recreation dominates these managed areas (5 percent), followed by roads at 3 percent (USFS,1995).

Map 16 (page 81) portrays the current general riparian conditions for the McKenzie watershed. High-quality and low-quality areas on this map, are differentiated by large woody debris recruitment potential. Although additional features, such as root mass and vegetation diversity also contribute to a high-quality riparian area, *Map 16* can help to identify potential priority restoration sites. High-quality riparian areas and off-channel sloughs in the lower McKenzie are especially important to juvenile salmon and many wildlife species. Riparian disturbance from development is most apparent along the lower and middle reaches of the mainstem McKenzie River and within the Mohawk watershed. Assessments of riparian conditions within the Mohawk and Lower McKenzie watersheds will provide valuable information to identify opportunities for demonstration projects and serve as a baseline to evaluate watershed health.

Residential development and Highway 126 has created low quality riparian conditions along the north bank of the mainstem McKenzie above and below Vida. Riparian conditions are also of relatively low quality in terms of large woody debris potential, along Quartz Creek, Blue River, Gate Creek, most of Deer Creek, and the lower portion of the South Fork McKenzie. High quality riparian areas are found mainly in the upper watershed areas of Horse Creek, White Branch, and upper Deer Creek.

For the mainstem McKenzie River, only 8 percent of the length includes mature to old growth forest along both banks of the river, and 92 percent of the river has experienced alteration of the streamside forest (Gregory et. al., 1992). Almost all of the riparian area in mature forest is in the upper river above McKenzie Bridge. Hardwood trees are gradually replacing conifers along the mainstem McKenzie corridor. Along most of the mainstem McKenzie, riparian area in mature conifers has decreased 44 percent from levels in the 1940s while hardwoods have increased 45 percent in the riparian area (Minear, 1994). Future wood loading to the channel is reduced by a decline in mature riparian vegetation, especially mature conifers.

Increased human use of riparian areas for roads, agriculture, and residential purposes has led to an increased fragmentation of the riparian landscape. The density of residential or developed areas within the riparian area of the mainstem McKenzie, between Leaburg and Trail Bridge dam, has increased 215 percent since 1945, as more and smaller areas are converted from natural vegetation to human use. Riparian area devoted to roads and residential uses has nearly doubled since the 1940s. Increased development in riparian areas including riparian clearing and rip-rapping along stream banks, may have negative long-term impacts to fish and wildlife species, including spring chinook and bull trout.

C. Riparian Area Regulations

1. *Forest Practice Rules*

Currently, privately owned commercial forest land is regulated by the Oregon Forest Practice Administrative Rules. Significant changes were made to these rules in 1994. These regulations specify riparian area protection standards varying according to stream size and beneficial use designation. Stream size classification is a function of the size of the drainage area and annual precipitation and classifications are separated into small, medium, and large streams. Beneficial use designations are as follows:

- Type F Stream - A stream with fish use, or both fish use and domestic water use.
- Type D Stream - A stream with domestic water use, but no fish use.
- Type N Stream - A stream with neither fish use nor domestic water use.

Table 6 presents riparian management area (RMA) widths for streams of various sizes and uses. Larger streams and those with designated beneficial uses have wider riparian management areas than smaller streams with fewer designated beneficial uses.

Table 6
Riparian Management Area Widths for Streams of Various Sizes and Beneficial Uses

	Stream Beneficial Use Type		
Stream Size	**Type F**	**Type D**	**Type N**
Large	100 feet	70 feet	70 feet
Medium	70 feet	50 feet	50 feet
Small	50 feet	20 feet	Apply specified water quality protection measures, and see OAR 629-640-200

Source: Oregon Department of Forestry, Oregon Forest Practice Rules, 1994

For all streams other than small, type N streams, forestry operators must retain all:

1. Understory vegetation within 10 feet of the high water level;
2. Trees within 20 feet of the high water level; and
3. Trees leaning over the channel.

In addition, operators must leave enough trees to achieve basal area specifications contained within the Forest Practices Rules. *Table 7* provides basal area requirements for Type F streams. *Table 8* shows basal area requirements for Type D and Type N streams. Requirements are more stringent for larger streams and those with designated beneficial uses. The Oregon Department of Forestry future conditions statement in the Oregon Forest Practice Rules, illustrates the agencies desire “...to grow and retain vegetation so that, over time, average conditions across the landscape become similar to those of mature stream side stands.” Basal area requirements are designed to achieve this desired future condition.

Table 7
General Prescription for Type F Streams for Clearcut Harvest Units and Partial or Thinning Timber Harvest
Oregon Interior and Western Cascade Region

Square Feet of Basal Area Per 1000 Feet of Stream, Each Side

Harvest Method	**Large Type F RMA =110 feet**		**Medium Type F RMA = 70 Feet**		**Small Type F RMA = 50 feet**	
	Standard Target	Active Mgmt. Target	Standard Target	Active Mgmt. Target	Standard Target	Active Mgmt. Target
Clearcut	270	200	140	110	40	20
Partial or Thinning	350	310	180	160	50	30

Source: Oregon Department of Forestry, Oregon Forest Practice Rules, 1994

Table 8
General Prescription for Type D and Large and Medium Type N Streams
Oregon Interior and Western Cascade Region

Square Feet of Basal Area Per 1000 Feet of Stream, Each Side

Harvest Method	Large Type D and N RMA = 70 Feet	Medium Type D and N RMA = 50 Feet	Small Type D and N RMA = 20 Feet
Clearcut	110	50	0
Partial or Thinning	160	60	0

Source: Oregon Department of Forestry, Oregon Forest Practice Rules, 1994

2. ***Lane County Riparian Ordinance***

Residential and commercial development within riparian areas are regulated by the Lane County Riparian Ordinance. This regulation governs vegetation removal and restoration work within the riparian area. Lane County requires a 100-foot setback from Class 1 streams for development on resource lands (forestry, agriculture, natural resources, marginal lands, parks and recreation, quarrying and mining, and destination resort). On non-resource lands (rural residential, commercial, industrial, and public facilities) the setback is 50 feet. Within the setback, a landowner may remove vegetation from up to 25 percent of the stream frontage of the lot. Vegetation can be altered as the landowner desires beyond the setback. These regulations also include provisions for granting variances, and mechanisms for enforcement, such as fines and restoration permit requirements. Agricultural lands are not covered by these regulations (Verret,1995).

V. Stream Habitat

Healthy stream habitat is essential for healthy wildlife, fish and other aquatic species. Stream habitat includes the area within the water of a stream or river including side channels and backwater sloughs. Important characteristics of stream habitat include large wood, coarse gravels, and pools. In addition, stream shading and barrier free passage is essential for migrating fish. Factors influencing stream habitat include numerous human activities (road building, stream bank stabilization projects, dams, timber harvesting, riparian vegetation clearing, etc.). These activities have generally resulted in an increase in fine sediments and water temperatures in some streams, and a decrease in the input of large woody debris, recruitment of coarse gravels and the number of pools. Some of these activities such as the construction of dams and road crossings may pose barriers to fish migration and movement.

A. Fish Distribution and Spawning

Improving wild fish numbers has been identified by the Oregon Department of Fish and Wildlife as a high priority related to stream habitat. Human created barriers to fish passage include culverts and dams. Each of the watershed analyses evaluate the location and conditions of culverts and road crossings. The majority of culvert barriers are road crossings on tributary streams. Dams have decreased the numbers of anadromous fish including spring chinook due to passage obstruction and increased and/or decreased water temperatures. Leaburg Dam at river mile 39 on the mainstem is the only dam with fish passage devices

The Oregon Department of Fish & Wildlife, McKenzie *Sub-watershed Fish Management Plan,* April 1988, includes the following high priority actions related to stream habitat: increase natural production of spring chinook; maintain high numbers of wild trout in areas not stocked with hatchery trout; monitor production and harvest of wild trout; increase survival of spring chinook and summer steelhead downstream migrants; reduce the impacts of Leaburg and Walterville canals on migration, spawning, rearing and angling; and reduce the impacts of timber harvest activities on fish production. McKenzie Watershed Council partner organizations have been pursuing activities that address some of the ODFW's action items. Some examples include: altered timber management practices and stream rehabilitation projects following watershed analyses that have been or are being conducted by the USFS, BLM, and Weyerhauser; proposed temperature retrofit projects at Cougar and Blue River Reservoirs by the ACOE; and streamflow increases and planned migration protection improvements proposed by EWEB.

Map 17 (page 83) displays the distribution of three fish species within the McKenzie watershed: wild spring chinook, hatchery salmon, and bull trout. Wild spring chinook are found along the entire length of the mainstem and most lower portions of large tributaries, such as Horse Creek, Gate Creek, and Deer Creek. Hatchery salmon are limited to the mainstem McKenzie below Leaburg Dam. Bull trout, a non-anadromous species, are found in somewhat isolated pockets mainly in headwater areas of Deer Creek, Horse Creek, and the South Fork McKenzie. There are no known spawning areas for these three species in the Mohawk or Blue River sub-watersheds

1. Spring Chinook

The historic spawning and rearing distribution of spring chinook includes the mainstem McKenzie up to Tamolitch Falls, Gate Creek, Horse Creek, Lost Creek, the South Fork of the McKenzie River, and Blue River. Spring chinook may also have been present in the Mohawk River until about 1910. Today the Mohawk River and Camp Creek are not considered suitable for adult spring chinook spawning because they lack holding pools, water is too warm during the summer, and flow is low during the spawning period. A few juveniles have been documented in the Mohawk¾ probably coming up the McKenzie River.

Data are available that show that spring chinook numbers have decreased since the completion of Cougar and Blue River dams (ODFW 1988). The estimated average run prior to construction of the dams was about 18,000 fish. Since the completion of the dams, the average run size has been about 6,700 fish with only about 2,900 passing upstream of Leaburg Dam. Construction of Cougar Dam is estimated to have blocked passage for about 4,000 spring chinook. ODFW has set as a goal to increase the average run for spring chinook to 18,000 fish (ODFW, 1988).

A change in water temperature in the McKenzie River following the construction of Cougar and Blue River Reservoirs is considered a partial cause for reduced spring chinook runs. Downstream temperatures are about 3°C-6°C higher in later summer and early fall and 8°C-12°C lower during spring and early summer than before construction of the dams. The warm water releases accelerate egg incubation resulting in earlier than normal fry emergence. Early emergence reduces fry survival because winter conditions are not favorable. Cooler than normal spring dam releases delay adult fish migration and the significant underutilization of available spawning habitat upstream of Leaburg Dam. The Army Corps of Engineers recently completed an Environmental Impact Statement to install temperature control devices on Cougar and Blue River dams.

Composition of the spring chinook run has shifted from a wild-production run of the late 1950s to a present run heavily supported by hatchery fish produced at the McKenzie Hatchery. Effects of hatchery stock hybridization with wild stock have shown weakened adaptations to local conditions and alter wild stock's ability to persist in their native environment (Waples, 1991). Some feel that because of the quality of the habitat, the spring chinook in the McKenzie River are currently the only population of spring chinook in the Willamette Basin that appear to be capable of self sustaining even though they are considered an "at risk" species. ODFW considers the McKenzie watershed the most important drainage in the Willamette Basin with remaining potential for natural spring chinook production. Historically, about 40 percent of the run coming over Willamette Falls (near Oregon City) was destined for the McKenzie River. In recent times (1984-1993), the McKenzie has contributed an average of only 17 percent of the run.

Increases in spring chinook production could be expected by maintaining and restoring channel complexity throughout the McKenzie system. The upper portion of the watershed remains in relatively good habitat condition. Increases in chinook production would likely come from restoration of lower river channels due to spring chinook life history requirements. The lower portion of the watershed provides important rearing habitat for juvenile salmon. Results from recent monitoring of downstream juvenile migration suggest a large portion of upper river offspring move to the lower McKenzie to rear. Due to a long period of freshwater residency (one to two years), juvenile spring chinook are particularly vulnerable to habitat degradation. The simplification of the lower McKenzie channels since the late 1800s has reduced the watershed's production capacity. Increasing channel complexity in these areas would likely provide substantial benefit. In addition, a reduction in harvest is an option to help restore fish numbers.

2. Bull Trout

Bull trout are the native char in the McKenzie River and are the only char native to the state of Oregon. The McKenzie bull trout are the only significant population remaining west of the Oregon Cascades. This population is still small compared to historic numbers. They are generally found in the upper stretches of the McKenzie River above Leaburg Dam, in Horse Creek, and the South Fork McKenzie River, above and below Cougar Reservoir.

Bull trout require a very narrow temperature range for spawning and egg incubation. Generally, bull trout are believed to need very cold water for spawning and rearing. In the past, logging activity has tended to increase water temperatures due to the removal of forest cover. This may contribute to the decline in bull trout populations. Bull trout also require specific habitats associated with complex cover consisting of in-channel woody debris, undercut banks, and pools. Bull trout are at risk because of over harvest, passage barriers, habitat destruction, and interbreeding with brook trout.

The U.S. Fish and Wildlife Service completed a survey and status report on bull trout in June, 1994. The study concluded that the bull trout is warranted for listing under the Endangered Species Act, but that other higher priority species precluded its listing at this time. Bull trout have been elevated to a category one status as a candidate species and additional impacts should be avoided and restoration opportunities identified.

Efforts to save bull trout from extinction in the mainstem McKenzie River have increased the numbers of bull trout redds found in some of the river's tributaries. As recently as 1993, only 16 or 17 bull trout redds were found in the annual stream survey. In fall 1995, there were 87 redds documented. Nine of these redds were in Olallie Creek, upstream from a new culvert placed under Highway 126 for the purpose of re-opening bull trout spawning areas cut off when the highway was built. Bull trout numbers seem to be increasing based on reports of anglers to the ODFW. A change in angling regulations is probably the main factor, with habitat improvement projects, such as new culverts, helping.

B. Habitat Features

Some of the habitat requirements for salmonid fishes, and stream or riparian values considered essential to productive aquatic systems include pool frequency, bank coverage and stability, wood within the stream, proper gravel composition, side channels, and channel position and sinuosity. An assessment of historical change of most of these features, along the mainstem McKenzie between Leaburg and Trail Bridge, was conducted by Paula Minear, of Oregon State University. *Table 9* presents major findings regarding stream habitat features that were segmented by reaches along the mainstem and are distinguished in *Figure 5*. Within Minear's study area, the mainstem McKenzie between Finn Rock and Rainbow has experience the most change regarding steam habitat features. Available information about these habitat features for the McKenzie watershed is presented below.

Table 9
Channel Position and Structure Changes from 1945/49 to 1986
McKenzie River From Leaburg to Trail Bridge Dam

Channel Feature	Overall Change from 1945-1986	Reaches Most Affected
Sinuosity	Decreased 2.4 %	Reach 4
Side Channel Length	Decreased 40%	Reaches 4 and 5
Exposed Gravel Bar Area	Decreased 57%	Reaches 5
Large Woody Debris	Decreased about 50 %	Reach 5
Large Pools	Decreased 19 %	Reaches 2 and 4

Source: Paula Minear, Historical Change in Channel Form and Riparian Vegetation of the McKenzie River, Oregon. Thesis

Figure 5
Stream Reach Designations Between Leaburg and Trail Bridge Dams

1. Large Woody Debris

Large wood is a major habitat characteristic by which healthy aquatic communities function. Large wood affects the occurrence and formation of pools and gravel deposits, sediment storage and routing, bank stability, and the overall complexity of a stream system. Large wood is also critical in the supply of organic debris necessary for macroinvertebrates and for the nutrient cycling process. The primary source of large wood is the adjacent riparian area.

Estimates of the amount of large wood present in the McKenzie River system prior to settlement are not available. Less large woody material has been noted in the mainstem channel since the 1940s, indicating a reduction in pool-forming agents and channel roughness elements. In this century it has been common practice to salvage wood that has fallen into or near the channel to market the lumber and to keep the channel passable. Timber harvesting near the mainstem McKenzie and removal of riparian vegetation for residential development and roads have reduced the number of available mature conifers for future recruitment into the channel (Minear, 1994). Large wood in the tributaries was historically removed during timber harvesting practices and cutting riparian vegetation close to these tributaries reduced the potential for further recruitment. Oregon's new stream protection rules in the Forest Practices Act should help to reduce these impacts.

Recently, increased attention has focused on the importance of riparian vegetation and large wood. Each of the watershed analyses conducted in the McKenzie watershed have evaluated stream segments for the presence of large wood. Several projects have occurred in the watershed to place large wood in streams from off-site sources. The long-term solution for addressing the objective to increase the amount of large wood will need to focus on future recruitment of wood from adjacent riparian areas. This solution should be closely tied to riparian management and buffer requirements. Encouraging planting of large tree species will help ensure large woody material for streams in the future. Of all channel features, large woody material often takes the longest period of time to replenish. Short-term habitat requirements require wood to be brought in from off-site.

2. Gravels

Stream gravels are an important habitat component for salmonid egg development. Historically, gravel was trapped and held by the presence of logs and boulders. As these structures were removed from streams, gravels have been transported through the stream system faster, especially during high water. Flooding has historically rearranged and loosened bottom gravels. With the reduction of flood events caused by dam construction, gravels especially within the mainstem McKenzie are increasingly becoming compacted. Dam construction has also contributed to a reduced supply of stream gravel.

3. Natural Side Channels and Sinuosity

Side channels and backwater sloughs provide important rearing habitat for juvenile fish, particularly salmonids. Reduced sediment supply, reduction of peak flows, plus the addition of near-channel roads and rip-rap to channelize the river, have constrained the active channel of the McKenzie within its banks. Confinement of the active channel over time gradually isolates secondary (side) channels from mainstem flow, reducing critical off-stream habitat. The Minear study found a decrease in side channel length on the mainstem McKenzie. Side channel length decreased 40 percent on the mainstem between Leaburg and Trail Bridge dams, with the most drastic change occurring between Rainbow and Finn Rock.

Over time, the McKenzie River has become increasingly straightened. Straight channels provide less habitat variability and fewer options for refuge for aquatic species. Channel straightening on the mainstem may be due to the interaction of several factors with high flow events: lack of stream structures, such as large wood, to deflect flow; presence of roads and rip-rap along the channel, which channelize and direct the flow; loss of riparian vegetation for bank stability; and human interaction (Minear 1994). Another factor of note is the decrease of peak flows by dams lowering the likelihood of overbank flows into the floodplain. Since the potential that new side channels and off channel habitat will be created naturally is minimal, the protection of those remaining areas, particularly in the lower river, is critical.

4. Pools

Available data indicate that there are fewer large pools today in the mainstem McKenzie, than existed in the late 1930s and early 1940s. The lower McKenzie River, between Leaburg Dam and the confluence with the Willamette, experienced a 67 percent reduction in large pools between 1938 and 1991. Frequency of large pools decreased 19 percent between 1945 and 1986 along the mainstem between Leaburg and Trail Bridge. The most affected reaches being between the South Fork and Rainbow and between McKenzie Bridge and Belknap Springs. Smaller, higher gradient tributary streams have also shown reductions in frequency of large pools when resurveyed by OSU and the USFS. Horse Creek showed a 38 percent loss of large pools, South Fork a 75 percent loss, and Augusta Creek saw a 48 percent reduction (Sedell et al., 1991).

Loss of large pools in the mainstem McKenzie above Leaburg Dam may be due to reduction in peak flows, channel straightening, and removal of large woody debris. Pools in the Minear study area often occur where the channel is abruptly deflected by bedrock, primarily at bends in the channel. When the bends are taken out by channel straightening, pool size may be diminished. At flows competent to move the largest substrate along the channel, pools remain scoured and the transported materials deposited in the riffles (Church and Jones, 1982). Reduction in peak flows will reduce opportunities for pool scour.

VI. Uplands

A. Uplands Definition, Functions, and Values

Uplands, also called terrestrial areas, are typically well drained areas that generally do not have standing water. Uplands are usually away from streams and outside of riparian areas. Uplands can be classified by the predominant type of vegetation on forest land: early seral, mid seral, and late seral. The term vegetation seral stage corresponds closely to vegetation age of forest stands. Early seral stage vegetation being similar to young forests about one to fifteen years, mid-seral forests are about 15 to 80 years in ages, and late seral forests greater than 80 years old. Several habitat types, referred to as special habitats, are contained within terrestrial areas. Special habitats include wet-lands, cliffs, meadows, and talus slopes (rock slides). Agricultural lands are also considered a special habitat and are valuable to several wildlife species. Uplands comprise almost 90 percent of all area in the McKenzie watershed.

The McKenzie watershed provides habitat for 329 known wildlife species (See Appendix C). The watershed contains no species unique to the McKenzie watershed. Three species, the peregrine falcon, spotted owl, and bald eagle are federally listed wildlife species. Recovery plans are in place for the peregrine falcon and bald eagle.

Uplands serve as important nesting habitat, roosting sites, hiding cover, and feeding sites for many wildlife species. These areas also provide travel corridors for animals moving throughout the watershed. In addition to wildlife values, terrestrial vegetation influences both the rate at which water runs off the land and the quality of that water. Densely vegetated slopes help to intercept rainfall, slow runoff, and reduce soil erosion. Slow moving water is absorbed into the ground readily and released over a long period of time.

B. Vegetation Composition

Harvestable forest lands account for 49 percent of the McKenzie watershed. Industrial forest companies manage approximately 45 percent of the harvestable base. These figures are approximate due to portions of industrial forest land subject to restrictions on harvest, such as riparian buffer zones, and some acres small woodland owners may log. One third of USFS lands within the watershed are in harvest allocations (USFS,1995).

Map 18 (page 85) shows the distribution of vegetation seral stages using a 1988 satellite image, updated for early seral to 1993. In the McKenzie watershed, vegetation age usually follows land ownership boundaries. Private forest lands in the lower watershed are generally younger than forests on public lands in the upper watershed. In general, the western half of the watershed contains a higher percentage of younger forests and hardwood species than the eastern half (the western half is also lower elevation and should not be expected to contain exactly the same vegetation as the eastern half).

Table 10 provides the number of acres of vegetation of different seral stages, by sub-watershed within the McKenzie. *Table 11* displays the percentage of seral stage vegetation by sub-watershed compared to the entire McKenzie watershed. The greatest amount of late seral stage forests remain in the South Fork, Upper McKenzie and Horse Creek watersheds within wilderness areas. A block of late seral forest also remains in the South Gate Creek area on USFS land and a smaller area in the Mohawk watershed on BLM land.

Table 10
Acres of Seral Stage Vegetation by Sub-watershed

Watershed Name	Early Seral	Mid Seral	Late Seral	Other Forest	Water	Non-Forest	Total Acres
Lower McKenzie	31,274	23,760	17,758	11,337	494	33,346	117,970
Mohawk River	33,533	26,557	18,675	11,973	0	22,888	113,626
Gate Creek	10,679	6,824	6,775	4,011	0	2,275	30,564
Middle Mckenzie	16,706	9,757	11,079	5,363	221	1,222	44,348
Quartz Creek	11,702	6,524	6,895	1,629	3	156	26,909
Blue River	23,583	8,190	21,654	4,253	791	496	58,967
South Fork Mckenzie	44,538	19,823	64,636	6,618	1,617	510	137,742
Horse Creek	25,614	18,280	50,177	3,161	173	4,872	102,277
Lost Creek/white Branch	7,964	4,541	9,296	1,289	72	6,504	29,666
Uper McKenzie	76,060	24,819	57,936	17,230	832	18,213	195,091
McKenzie Watershed Total	**281,652**	**149,075**	**264,881**	**66,864**	**4,204**	**90,483**	**857,159**

Source: 1988 Landsat TM Imagery, updated to 1993 by the BLM

Definitions:
Early Seral = 10-70% total crown closure in conifers, and <75% hardwoods and shrubs (conifers approximately 1-15 years).
Mid Seral = 40-100% total crown closure in conifers, and <10% crown closure in conifers >or =21” in diameter, and <75% hardwoods and shrubs (conifers approximately 15-80 years).
Late Seral = 40-100% total crown closure in conifers, and >10% crown closure in conifers >or=21” in diameter, and <75% hardwoods and shrubs (conifers approximately 80+ years).
Other Forest = < 10% total crown closure and/or > 75% in hardwoods and shrubs; Non-Forest = agriculture, urban, rock outcroppings

Table 11
Percent Seral Stage Vegetation by Sub-watershed

Watershed Name	Early Seral	Mid Seral	Late Sera
Lower McKenzie	26.5%	20.1%	15.1%
Mohawk River	29.5%	23.4%	16.4%
Gate Creek	34.9%	22.3%	22.2%
Middle McKenzie	37.7%	22.0%	25.0%
Quartz Creek	43.5%	24.2%	25.6%
Blue River	40.0%	13.9%	36.7%
South Fork McKenzie	32.3%	14.4%	46.9%
Horse Creek	25.0%	17.9%	49.1%
Lost Creek/White Branch	26.8%	15.3%	31.3%
Upper McKenzie	39.0%	12.7%	29.7%
Total	**32.9%**	**17.4%**	**30.9%**

Source: 1988 Landsat TM Imagery, updated for to 1993

Definitions:

Early Seral = 10-70% total crown closure in conifers, and <75% hardwoods and shrubs (conifers approximately 1-15 years).
Mid Seral = 40-100% total crown closure in conifers, and <10% crown closure in conifers >or =21” in diameter, and <75% hardwoods and shrubs (conifers approximately 15-80 years).
Late Seral = 40-100% total crown closure in conifers, and >10% crown closure in conifers >or=21” in diameter, and <75% hardwoods and shrubs (conifers approximately 80+ years).
Other Forest = < 10% total crown closure and/or > 75% in hardwoods and shrubs
Non-Forest = agriculture, urban, rock outcroppings

C. Wildlife Suitability Analysis

A landscape analysis of upland habitat suitability for wildlife in the McKenzie watershed was conducted using a habitat suitability model called "Habscapes." The model, developed by the U.S. Forest Service, evaluates the suitability of habitat for wildlife species guilds or groups of species with similar habitat requirements. Habitat suitability is defined as habitat which is suitable for a species to meet all of its life needs including breeding. Some of the factors influencing habitat suitability include the age, type, and location of the habitat and size of the habitat patch. Some species, such as the northern spotted owl, are thought to be very specific about their habitat requirements while others may use a variety of habitat types.

In essence, the Habscapes model evaluates the suitability of habitat for all wildlife species suspected to occur in the watershed. The model has the ability to evaluate habitat suitability for riparian, terrestrial, or special habitats. Maps generated from these analyses are useful in displaying habitat distribution, identifying rare habitats, habitat corridors, and gaps in habitat. Due to limited information, only terrestrial habitats were evaluated in the McKenzie watershed.

1. Methodology

The base layer for the analysis was an updated 1988 satellite image divided into vegetation seral stages. Analysis of habitat suitability for the McKenzie watershed involved developing and linking several databases. The first step in the process involves developing a wildlife habitat relationships database. The database contains information on 329 wildlife species that are permanent or part-time residents in the watershed. Information on a species habitat, size, reproductive rate, home range size, and habitat utilization strategy is included in this database.

The second component of the process aggregates all animals in the landscape into groups of species with similar habitat requirements (life-history guilds). Species were first divided into three groups based on whether the species is terrestrial, riparian, or requires a specialized habitat, such as wetlands. The screening criteria focus on where a species breeds. Terrestrial wildlife species were then further stratified into home range size, habitat usage, and the seral stage of the forest used by the animal. This stratification is shown in *Table 12*.

Although base information is not available at this time to allow analysis of riparian areas or special habitats, these areas will be evaluated when information is available. *Table 13* shows how riparian wildlife species can be stratified by whether they used the water portion of the riparian area, the vegetated area adjacent to the waterway, or the terrestrial area adjacent to the riparian habitat. The analysis could also include what seral stage of the terrestrial area is used by the riparian wildlife species. Unique species or those with special habitat needs (e.g., wetlands, caves, talus slopes, waterfalls, cliffs, agricultural lands, etc.), do not fit well into guilds, but were also identified in the analysis.

Table 12
Stratification of Terrestrial Species

Home Range Size	Habitat Utilization Strategy	Seral Stage Use
a. Small	a. Patch Species – likely to use one homogeneous patch	a. Early Seral Forest Habitat
b. Medium	b. Mosaic Species – able to aggregate like patches	b. Mid Seral Forest Habitat
c. Large	c. Contrast Species – utilize edges	c. Late Seral Forest Habitat
	d. Generalist Species – use all or many types of habitat	d. Uses any Seral Stage

Table 13
Stratification of Riparian Species

1. Uses Aquatic Portion of Riparian Habitat Only
2. Uses Aquatic Portion of Habitat and Forested Banks
3. Uses Forested Vegetation Along Banks Only
   a. Uses Early Seral Forests
   b. Uses Mid Seral Forests
   c. Uses Late Seral Forests
   d. Uses any Seral Stage

The aggregation of wildlife species for the McKenzie watershed resulted in the identification of 16 terrestrial guilds, seven riparian guilds, and 35 separate special habitat species.

The third step in the process involves a vegetation database. A vegetation database for the watershed was produced by updating a 1988 digital satellite image to depict 1993 vegetative conditions in the watershed. The vegetation database was then stratified into early, mid and late seral forest stages. The resulting terrestrial guilds were then linked to a spatially-referenced vegetation database using a common vegetation/habitat classification scheme. Basically this analysis involves centering a home range-radius circle on each pixel and records:

- If the pixel is part of a patch of habitat the guild would use;
- If the home range radius circle contains other patches of like habitat; and
- How each patch contributes to minimum habitat needs within that home range.

As stated above, due to limited vegetation mapping in riparian and special habitats, only terrestrial habitats have been evaluated at this time. The maps produced for terrestrial habitat guilds depict the quality of each habitat patch. The maps were then evaluated by vegetative patterns, their composition, and how they contribute to species home range habitat needs.

2. Assumptions and Limitations

The model is based on several assumptions, and thus has limitations. Assumptions and limitations include:

1. Assesses habitat for individuals of species not for populations, and thus does not assess species viability.

2. Assesses primary or good habitat, not marginal habitat. Individuals of species may occur in areas not identified as habitat by the model. The assumption is that some individuals will occupy marginal habitat, but the fitness of these individuals is expected to be less than for individuals occupying good habitat.

3. The output generated from the model is a list of species that may occur in the landscape and the number of acres available for the guild to which each species belongs. If a species is on the list, it is assumed that the landscape is capable of supporting at leastone individual of the species on the list. The acres available for each guild can be used to estimate the expected number of individuals of a species, based on that species home range size (not necessarily the guild home range size) that may occur in the landscape.

4. Results for each guild are a generalization for those species in the guild. The results may be an overestimate of habitat for some species and an underestimate for others. An overestimate would occur if species used just a subset of specific habitats within the broad habitat category used for the guild (e.g., cavity nesters would only use the general habitat if snags were also present at appropriate levels). An underestimate would occur for species with less stringent requirements that those for the guild in general (e.g., some species may be able to use patches of habitat smaller that the minimum size identified for the guild).

5. The guild approach to assessing habitat is meant to be a “screen” to determine if adequate habitat occurs in a watershed for species that we expect to react to different distributions and amounts of habitats in similar ways. The guild level analysis may help to flag groups of species which may be of concern due to limited availability of habitat, but will not replace single species analysis for threatened, endangered, or sensitive species or other species of concern.

6. Species that require a special or unique habitat (e.g., wetlands, meadows, cliffs, etc.) need to be assessed individually. Habitat requirements for these species are unique and grouping into guilds is not feasible.

7. In this process, the landscape level analysis was used to assess habitat for guilds of species. However, the model could be used to assess individual species. Species specific

habitat and life history parameters could be used as input to the models rather than generalized parameters for the guild.

8. The model assumes that lands outside the boundary of the analysis area "mirror" the vegetation pattern of lands inside the boundary. For pixels at the edge of the analysis area the percentage of habitat in the home range circle is averaged for the known lands and that average is used for the unknown lands. The analysis area can be "buffered" with known or interpreted vegetation information if this assumption is not satisfactory.

3. Results

Habitat maps for 12 of the 16 terrestrial guilds were produced. *Maps 19 and 20* (pages 87, 89) are two of the maps produced and serve as examples. The Fish and Wildlife Habitat Task Group (Appendix C) evaluated the maps and developed conclusions. Results of the model will be quantified into number of acres in each suitability class as refinements to the base information is completed. Results of this evaluation are described below:

- The majority of habitat suitable for species associated with edges (e.g., red tailed hawk, Roosevelt elk) occurs in the eastern portion of the watershed on federally managed lands. This may shift over time as the President's Plan on USFS lands reduces the availability of early seral patches.

- Habitat for late successional species (e.g., spotted owl and red tree vole) should increase on USFS lands under the President's Plan.

- Species requiring small to mid size early seral habitat patches (e.g., American goldfinch, black-tailed rabbit, western terrestrial garter snake) generally have abundant suitable habitat now, although, this habitat type is highly transitional on all ownerships.

- There is an abundance of mid-seral habitat used primarily by generalist species such as black bear and western tanager throughout the watershed. However, the majority of these stands lack the structural complexity that increase their value for all species.

- The highest quality late successional habitat for mosaic species occurs in the higher elevation wilderness areas around Gate Creek. Distribution of this habitat type may be limited in the future.

- Management activities such as fire suppression, timber harvest, and road construction have affected the structure and composition of upland habitats. Managed stands are generally lacking the structural components, and the size/shape of patches are probability trending outside the natural range of variability. Fire suppression in unmanaged stands, particularly in the higher elevations, have resulted in structural conditions that are trending outside the range of natural variability.

Map 16

(Large Woody Debris Recruitment Potential)

Map 17 - Fish Spawning Distribution Map

Map 18 - Vegetation Seral Stage Map

Map 19

Guild Map, Terrestrial, Large Home Range, Mosaic, Late Seral

Map 20
Guild Map, Terrestrial, Small Home Range, Mosaic Early Seral

Chapter Four

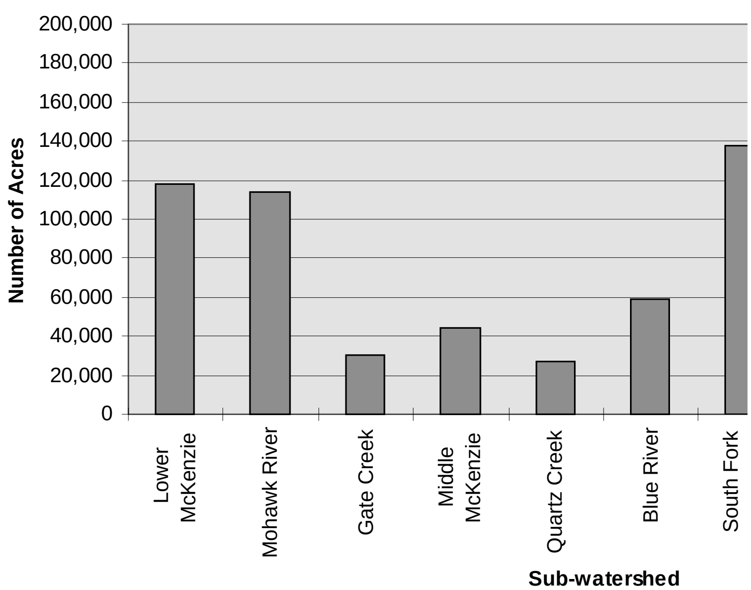
Sub-Watershed Fish and Wildlife Habitat Conditions

I. Introduction

This chapter provides additional information about fish and wildlife habitat conditions for the ten sub-watersheds within the broader McKenzie watershed. Sub-watersheds vary in past and current land use which has influenced upland vegetation types, riparian conditions, and habitat for fish and other aquatic organisms.

Figure 6 compares sub-watershed sizes and *Map 21* (page 101) distinguishes boundaries. The entire McKenzie watershed totals 857,157 acres (1340 square miles). The Upper McKenzie and the South Fork are the largest sub-watersheds comprising 23 percent and 16 percent, respectively, of the total McKenzie watershed. Gate Creek, Quartz Creek and White Branch are the smallest areas, with 4 percent, 3 percent and 4 percent, respectively.

Figure 6
Size Comparison of McKenzie Sub-watersheds



Source: 1988 Landsat TM Imagery, updated to 1993

II. Existing Watershed Analysis Data

Several watershed analyses and studies, as shown on *Map 22* (page 103), have been or will be conducted within a number of sub-watersheds of the McKenzie. The intent of a typical watershed analysis is to develop and document a scientifically based understanding of the processes and interactions occurring within a watershed. Gaining an understanding of the interactions between land-use activities and the physical and biological environment help guide sound management decisions.

The USFS has completed a watershed analysis for the South Fork McKenzie and one for the Upper McKenzie. Analyses on all USFS managed lands within the McKenzie will be completed by the end of fiscal year 1997. Within the Deer Creek watershed of the middle McKenzie, the USFS will conduct the Long-Term Ecosystem Productivity (LTEP) research study. An extensive tracking system is included in the 200 year life of the study. The BLM completed the Mohawk/McGowen Watershed Analysis in May 1995. Part of the analysis on the upper reaches of the Mohawk River was conducted jointly with Weyerhaeuser Company. The BLM is in the process of conducting an analysis for BLM lands within the vicinity of Vida.

Weyerhaeuser Company is the only private entity to conduct watershed analyses within the McKenzie. The methodology used in their analysis is similar in some respects to that used on the public lands except that less emphasis is placed on upland wildlife species. Weyerhaeuser Company has completed analyses in the Mill Creek and upper Mohawk drainages of the Mohawk watershed and on tributaries along the south bank of the McKenzie River from Osborn Creek near Cedar Flat east to Deer Creek, and on tributary creeks on the north side of the McKenzie River from Potter Creek east to Gate Creek. Other studies include an analysis of historic change for the mainstem McKenzie from Trail Bridge Reservoir to Leaburg Dam by a graduate student at Oregon State University. A look at the geomorphology of the lower McKenzie River from Leaburg Dam to the confluence with the Willamette River has been provided by EA Engineering for EWEB.

The largest remaining information gap is in the lower watershed on small acreage private lands in the Mohawk watershed and along the mainstem McKenzie River. Stream surveys are lacking for many streams, particularly on private land.

III. Lower McKenzie

The Lower McKenzie sub-watershed is the westernmost area in the McKenzie watershed. About 118,000 acres are within the area, nearly 14 percent of the total McKenzie watershed. The Lower McKenzie contains a diverse mix of urban, rural, agricultural, industrial, and forest land uses and both public and private ownerships. Vida, Leaburg, Walterville, and part of the City of Springfield are urban areas contained within the Lower McKenzie. Higher development in this portion of the McKenzie has influenced fish and wildlife habitat features. Residential and industrial development has resulted in removal of riparian vegetation and rip-rapping river banks. Water corridors tend to be more channelized resulting in the loss of backwater/off channel rearing habitat, and islands. Urban, industrial, and agricultural stormwater runoff potentially influences both the quantity and quality of water entering the McKenzie.

Weyerhaeuser Company has completed two watershed analysis in the lower McKenzie sub-watershed: *Lower McKenzie North Side Watershed Analysis*, 1995 and *Lower McKenzie South Side Watershed Analysis*, 1994. The BLM is also completing the Vida McKenzie Watershed Analysis for the upper parts of the Lower McKenzie.

Compared to other sub-watersheds within the McKenzie, the Lower McKenzie contains the highest amount (28.3 percent), of non-forest use, mostly agriculture and urban. Nearly 62 percent of the watershed is early, middle, or late seral vegetation. About 43 percent of this vegetation is recent early seral vegetation. Within the sub-watershed as a whole, only about 15 percent of the area is in late seral stage vegetation. In terms of potential for the recruitment of large woody material, riparian areas within the entire length of the Lower McKenzie, are of relatively poor quality.

The Lower McKenzie River flows through the center of the watershed land area and is considerably wider and slower than upstream segments of the river. This river segment extends from just below Finn Rock, flowing west to the confluence with the Willamette near the City of Coburg. Anadromous fish entering the watershed, use this river section as the primary migration corridor for upstream passage. This stretch of the river also provides an important spawning and rearing area for spring chinook salmon. Results from monitoring of downstream juvenile migration suggest a large portion of upper river offspring move to the lower McKenzie and Willamette to rear. Large numbers of fry have been observed moving past Leaburg dam, leaving the upper river soon after emergence. Due to a long period of freshwater residency, (one to two years), juvenile spring chinook are particularly vulnerable to habitat degradation. The simplification of the Lower McKenzie has reduced the watershed's production capacity, and the loss of rearing capacity there likely limits production in the upper basin (USFS,1995). Hatchery salmon are confined to this section of the river due to the inability to travel past Leaburg Dam.

IV. Mohawk

The Mohawk sub-watershed contains about 113,700 acres, 13 percent of the McKenzie watershed. A wide mix of land uses, including; agriculture, forestry, and rural development are contained within the watershed. About 76 percent of the Mohawk area is private holdings and 24 percent Bureau of Land Management (BLM) lands. Both Weyerhaeuser Company and the BLM have completed watershed analyses within the Mohawk which have helped to quantify some of the issues facing the watershed

Thirty percent of the Mohawk area is in early seral vegetation and about 20 percent in non-forested areas mostly agriculture and rural residential. Late seral forest comprise only 16.4 percent of the Mohawk watershed, the second lowest percentage in the McKenzie. Due to the large percentage of private forestry land, the majority of forests in the Mohawk watershed are expected to be harvested for timber production at about a 40-50-year rotation. Riparian areas along the Mohawk River and its tributaries, tend to be in poor shape primarily due to vegetation removal.

The 26-mile-long Mohawk River runs down the center of the watershed with a gradual average gradient of 31 feet/mile. The Mohawk River enters the McKenzie River at river mile 13.7 contributing an average annual discharge of 524 cfs. Base flow for the Mohawk River is low when compared to most other rivers. Average base flow (low flow) for the Mohawk River is about 19 cfs with a range between 10 cfs and 34 cfs. A minimum flow of 20 cfs is required to be released from the Mohawk River for aquatic habitat and for downstream users (BLM, 1995). There are about 139 water rights in the Mohawk watershed causing an over appropriation of water in some years.

The Mohawk River historically contained a small run of chinook salmon but today only a few stray fish enter the river. Bull trout or hatchery salmon are also generally not found within the entire watershed. Cutthroat trout are common in the upper river and all perennial-flowing tributaries. Summer water temperatures are too high in the Mohawk River to support salmonids and some other aquatic organisms Stream habitat features, such as boulders and large woody debris have declined from historic levels and upland land uses have increased sediment levels. Nutrient releases from agricultural runoff, and lack of exclusion fencing to restrict cattle from stream edges, has also contributed to the general degradation of the aquatic system in the Mohawk sub-watershed.

The East Lane Soil and Water Conservation District with assistance from the Natural Resource Conservation Service have assisted several private property owners with financial and technical assistance to complete restoration work within the watershed.

V. Gate Creek

The 30,600-acre Gate Creek sub-watershed comprises less than 4 percent of the McKenzie watershed. Gate Creek watershed contains a combination of public and private ownership. Most of the area is in private lands at 80 percent private ownership. Public lands consist of 12.6 percent being under the USFS and 4.8 percent managed by BLM. In 1995 Weyerhauser completed a watershed analysis for this area.

The watershed contains mostly forest land uses with about 35 percent in early seral stage vegetation. The largest and highest quality patch of late seral forest habitat, outside of wilderness areas in the McKenzie watershed, is within the Gate Creek area. This area serves as an anchor for late seral species within the Central Cascades Adaptive Management Area. In the entire McKenzie, Gate Creek watershed also contains the highest percentage of “other” forest types at 13.1 percent. Other forest types are those with less than 10 percent total crown closure and/or greater than 75 percent in hardwoods and shrubs. Riparian conditions are of relatively poor quality in terms of large woody debris recruitment potential.

North and South Gate Creek generally flow in a southwest direction converging lower in the sub-watershed and joining the mainstem McKenzie just above Vida. Gate Creek adds an average of 214 cfs to the mainstem McKenzie annually. Gate Creek provides important spawning habitat for spring chinook salmon and rainbow and cutthroat trout. Lack of large woody debris recruitment potential limits the quality of riparian areas adjacent to water corridors in the watershed. The combination of salmon spawning, low quality riparian conditions, and the majority of the area being in private ownership make this sub-watershed a priority riparian restoration area using incentives.

VI. Middle McKenzie

The Middle McKenzie sub-watershed extends from Deer Creek west of Finn Rock to east of McKenzie Bridge. This sub-watershed contains about 44,400 acres, approximately 5 percent of the total McKenzie watershed. Ownership within the watershed includes private holdings (58 percent) along the river, and BLM (4 percent) and USFS (37 percent) land higher up. The unincorportated communities of Finn Rock, Blue River, Rainbow, and McKenzie Bridge all lie within the Middle McKenzie watershed.

The USFS has established a Long Term Ecosystem Productivity Planning Area on upper Deer Creek to study forest practices over a long period of time in that area. Weyerhaeuser Company has conducted a watershed analysis for the lower portion of Deer Creek.

Late seral vegetation comprises one-fourth of the entire Middle McKenzie area. Almost 38 percent of the sub-watershed is in early seral vegetation indicating the importance of the forestry industry in this area. Mature conifer amounts within riparian areas, have decreased by about 44 percent since the 1940s along the mainstem McKenzie of this section. Hardwoods have increased by about 45 percent along some reaches of the river (Minear, 1994). Riparian zone conditions tend to be of high quality on the south side of the Middle McKenzie River and of poorer quality on the north side due to highway 126 and residential development. Increasing development pressure along the mainstem may continue to have negative impacts on riparian vegetation and stream habitat.

Major tributaries, including, Blue River, Quartz Creek, South Fork McKenzie River, and Horse Creek more than double stream flow of this 22-mile section of the mainstem McKenzie River. Average annual streamflow at the USGS gauging station (McKenzie River mile 69.9) just above Horse Creek, is 1,675 cfs compared to 4,014 cfs at river mile 47.7 between Gate Creek and Quartz Creek. The mainstem McKenzie, provides critical habitat for spring chinook salmon and is an important migration corridor for spring chinook. Habitat quality has decreased since the 1940s on some reaches of the mainstem Middle McKenzie. The reach between the confluence of the South Fork and Rainbow shows a decrease in channel sinuosity, fewer large pools, and at least a 40 percent decrease in side channel length. Between the South Fork and Finn Rock, the river has experienced a decrease in large woody debris, less exposed gravel bar area, and a decrease in side channel length (Minear, 1994).

VII. Quartz Creek

Quartz Creek, is the smallest sub-watershed consisting of 26,900 acres and comprising only 3 percent of the total McKenzie watershed. Ownership includes mostly private owners in the lower section and USFS ownership in the upper part. Most of the private land within the watershed is used for timber production with no residential development existing in the entire sub-watershed. To date, there has been no watershed analysis work, but the USFS has proposed a Quartz Creek watershed analysis to be conducted in fiscal year 1997.

Early seral vegetation comprises about 43.5 percent of the sub-watershed (the highest percentage within the McKenzie watershed). This sub-watershed also contains the highest percentage of mid seral vegetation at 24 percent. About one-fourth of the area is in late seral vegetation. Forested vegetation removal along Quartz Creek has resulted in riparian areas with limited ability to provide large woody debris to the stream channel. Upper Quartz Creek is the site of a stream restoration research project which includes the placement of large woody debris.

Quartz Creek flows in a generally southern direction until it converges with the mainstem McKenzie near the small community of Finn Rock. Average annual stream flow for Quartz Creek is about 200 cfs where it discharges into the mainstem McKenzie. Spawning habitat for spring chinook is provided in the lower section of the creek and rainbow and cutthroat trout further up

VIII. Blue River

The Blue River sub-watershed contains about 59,000 acres, 7 percent of the McKenzie watershed. This sub-watershed lies within both Lane and Linn Counties and approximately 84 percent is under USFS ownership. Blue River reservoir lies about 2 miles up Blue River and is the site of an Army Corps of Engineers temperature control proposal. H.J. Andrews Experimental Forest is also located within the sub-watershed providing long- and short-term forestry research opportunities. A Blue River/Calapooia watershed analysis is scheduled to be completed by the USFS in 1996.

Blue River watershed has one of the highest percentages of early seral vegetation at 40 percent. About 37 percent of vegetation is in late seral stage. Due to a large amount of past timber harvesting, riparian vegetation above Blue River dam is relatively degraded. Large woody material recruitment potential from most riparian areas within this watershed is limited.

Blue River generally drains in a southwest direction until it converges with the mainstem McKenzie near the unincorporated community of Blue River. Near this confluence, Blue River has an average annual discharge of 449 cfs. This waterway provides habitat for spring chinook salmon from the confluence with the McKenzie River to the reservoir. Blue River dam presents a barrier to fish migration above the reservoir. Cutthroat and rainbow trout are found throughout the sub-watershed. Lookout Creek, flowing into Blue River reservoir in the north, provides relatively high quality stream habitat and is the site of numerous long-term USFS biological studies.

IX. South Fork McKenzie

The South Fork McKenzie sub-watershed, at 137,800 acres, is the McKenzie's second largest, comprising 16 percent of the total watershed. Ownership in the sub-watershed includes 94 percent USFS, 2.5 percent Army Corps of Engineers, and 4 percent private holdings. Cougar Reservoir lies about three miles up the South Fork McKenzie River. The reservoir's dam is also under consideration for the installation of temperature control devices. A watershed analysis has been conducted on the South Fork by the USFS.

The South Fork contains about 32 percent early seral vegetation. About 47 percent of this sub-watershed is in late seral vegetation. At 64,636 acres, this is the largest amount of late seral vegetation contained within any sub-watershed within the McKenzie watershed. Riparian areas in the upper portions of the watershed have a high potential for the recruitment of large woody debris into the stream system. The south Fork McKenzie is surrounded by mature and old growth stands. Douglas fir forests generally dominate the corridor, and there are also stands of western hemlock, mountain hemlock, true firs, western red cedar and white pine. Large woody debris potential is poor, lower in the watershed. The South Fork corridor offers diverse habitat for wildlife such as elk, deer, bobcat, coyotes, hawks, stellar jays, pileated woodpeckers, and Douglas squirrels. The entire length of the corridor is designated big game winter range (Water Resources Department, 1991).

Field studies indicate that a federally listed sensitive species, the red legged frog, is found in riparian areas along the lower terminus of the South Fork. The northern spotted owl is not known to nest in the river corridor, however, adjacent to the river is old-growth habitat associated with this species. Bald eagles have been sighted above the reservoir and two areas near the reservoir are recognized as potential roosting and nesting sites (USFS, 1990).

The South Fork drainage is associated with steep, highly dissected stream channels. The South Fork River drops 3,500 feet along its entire length, with an average gradient of 110 feet per square mile. This river is a state scenic waterway and has been determined eligible for inclusion into the wild and scenic river system, but is waiting further action. The South Fork River flows in a northerly direction until it discharges into the mainstem McKenzie about three miles above the community of Blue River. Average annual discharge for the South Fork, is about 846 cfs at the USGS gauging station just before the confluence with the mainstem McKenzie.

The South Fork McKenzie River provides habitat for Bull trout primarily in the segment above Cougar Reservoir. Rainbow and cutthroat trout are common throughout the sub-watershed. Significant loss of chinook spawning habitat occurred with construction of Cougar dam which blocked spawning habitat for about 4,000 fish.

X. Horse Creek

The Horse Creek sub-watershed contains about 102,300 acres, 12 percent of the McKenzie watershed. Nearly all of the watershed is owned and managed by the USFS. Comprehensive data collection for the watershed has not yet been undertaken, but the USFS has proposed a watershed analysis for fiscal year 1997.

One-fourth of the Horse Creek land area is early seral vegetation, the smallest percentage of all the sub-watersheds. Nearly half (49.1 percent) of the sub-watershed is in late seral vegetation. Compared to other sub-watersheds, it is the highest percentage of seral stage vegetation for any single sub-watershed and the third highest in total acres (50,177 acres). Land uses on unstable slopes have triggered land slides in some areas of the sub-watershed. Forested riparian areas are of high quality, with large woody debris recruitment potential benefiting stream habitat conditions.

Horse Creek flows in a northwest direction discharging an annual average of 504 cfs into the McKenzie River near river mile 66. Horse Creek has some of the highest quality riparian and stream habitat conditions in the McKenzie watershed. With its headwaters in the wilderness area, Horse Creek provides important spawning areas for bull trout, spring chinook, and cutthroat and rainbow trout. The area around the confluence of Horse Creek and the McKenzie River has been identified as being very important for fish productivity. This delta area contains side channel habitat and riparian area diversity and shading necessary for spring chinook spawning and rearing.

XI. White Branch/Lookout Creek

With 29,700 acres, White Branch is the second smallest sub-watershed, comprising only about 3.5 percent of the McKenzie watershed. About half of the White Branch watershed is contained within the Three Sisters Wilderness Area and over 99 percent is in public ownership. The USFS Upper McKenzie Watershed Analysis, completed in 1995, includes the White Branch area.

About 27 percent of the White Branch watershed is early seral vegetation and 31.3 percent in late seral forest. In addition, about 22 percent of the watershed is classified as non-forest mostly in rock outcroppings and lava. Riparian vegetation conditions are generally of high quality within this sub-watershed.

White Branch flows in an westerly direction contributing an average discharge of 300 cfs to the McKenzie River near the McKenzie headwaters. Spring chinook use the lower White Branch for spawning and rearing. The potential for spring chinook production is underused based on historical data. Similar to the Horse Creek sub-watershed, the confluence of White Brach and the McKenzie River contains a delta that is critical for spring chinook productivity.

XII. Upper McKenzie

The Upper McKenzie watershed, at 195,200 acres, is the largest sub-watershed within the McKenzie, representing about 23 percent of the watershed. About 97 percent of the Upper McKenzie is under USFS management including parts of the Mt. Jefferson, Mt. Washington, and Three Sisters Wilderness areas. A mixture of private timber production and residential use occur on the remaining 3 percent of the land. Three reservoirs are within this sub-watershed including; Smith River, Trail Bridge, and Carmen. An Upper McKenzie watershed analysis was completed by the USFS in 1995.

The Upper McKenzie contains the most acres of early seral vegetation at 76,060 acres, about 39 percent of sub-watershed. About 30 percent of the area is in late seral vegetation, for a total of 57,936 acres. Relative to other sub-watersheds, the Upper McKenzie watershed has the smallest percentage of mid seral vegetation at 12.7 percent. In addition, about 9 percent of the sub-watershed consists of interesting and unique plant communities that are considered non-forest. Extreme ranges in temperature, wind, elevation, and soils contribute to making this a unique botanical area.

There are 60 species of wildlife within this sub-watershed that use riparian areas as primary habitat for breeding and for feeding. The majority (30 percent) are migratory waterfowl. Thirteen of these species require mid or late seral forests adjacent to class 1-3 streams, lakes, and ponds (USFS, 1995). Compared to other sub-watersheds, riparian areas in the Upper McKenzie are of relatively high quality with the exception of Deer Creek.

The Upper McKenzie contains the headwaters of the McKenzie River at Clear Lake and Santiam Pass, an important low level pass and wildlife travel corridor. The Upper McKenzie River flows out of Clear Lake through a narrow gorge in volcanic rock. Just beyond Koosah Falls, the Upper McKenzie is intercepted by Carmen reservoir which diverts the river westward into Smith reservoir. From there, the water flows south and then east, and finally returns through hydroelectric turbines at Trial Bridge reservoir.

The Upper McKenzie River supports approximately 20 species of fish. The McKenzie River up to

Trail Bridge Reservoir provides spawning habitat for spring chinook salmon. The upper watershed remains in relatively good habitat condition, providing habitat for spring chinook stocks. Spring chinook seek out cool water temperatures in the Upper McKenzie and use gravel and cobble-rich portions as spawning habitat. In addition, bull trout can be found in several small creeks in the area including Anderson Creek, Ollalie Creek, and Norwegian Creek just south of the reservoir. Bull trout isolated above Trail Bridge dam are at a high risk of extinction. Risks come from low population size, passage barriers, over harvest of fish, habitat degradation, competition with brook trout, and limited available spawning habitat. This Trail Bridge sub-population is in the process of being reestablished. Bull trout fry are being reseeded upstream of the dam in an effort to reestablish spawning and rearing habitat and to strengthen the number of Trail Bridge bull trout (USFS,1995). Steelhead salmon are known to spawn in Deer Creek within this watershed.

XIII. Opportunities for Fish and Wildlife Habitat Maintenance and Improvement

The McKenzie Watershed Council emphasizes a proactive approach to maintaining and improving fish and wildlife habitat conditions within the McKenzie watershed. Although conditions are generally good in most areas, there are opportunities to maintain high quality areas and improve lower quality habitat conditions. These opportunities include:

- Identify priorities and opportunities for restoration or enhancement of riparian vegetation.
- Encourage voluntary riparian conservation, restoration, and enhancement projects.
- Identify opportunities for protecting high quality off channel habitat, islands, and riparian vegetation.
- Identify opportunities for installing livestock exclusion fencing along streams.
- Identify and correct barriers to fish migration.
- Protect delta areas for fish spawning and rearing.
- Identify opportunities for upland restoration.
- Encourage urban stormwater management planning and best management practices in urban areas of the watershed.
- Encourage agricultural and industrial best management practices.
- Encourage voluntary conservation and improved efficiency of irrigated lands.

MAP 21
SUBWATERSHED BOUNDARIES MAP

MAP 22

WATERSHED ANALYSIS STUDY LOCATIONS

Chapter Five

Priority Actions Selection Process
and Possible Future Actions

I. Introduction

This chapter describes the process the council used in identifying its priority actions related to water quality and fish and wildlife habitat. Included is a list of brainstormed actions related to water quality and fish and wildlife habitat. It was from these lists that the council's priority action clusters were identified. The council's priority actions clusters are explained in detail in the Action Plan. Additional actions proposals are included in the appendix for future consideration by the council.

II. Action Identification

The council brainstormed a list of actions during a special work session in April 1995. In preparing for the brainstorm, partners reviewed background material including:

- Council's program and process objectives (See Appendix D),
- Existing conditions and trends affecting water quality and fish and wildlife habitat in the McKenzie watershed, and
- Comprehensive list of actions previously undertaken or proposed (See Appendix E).

The council's program and process objectives provided the *big picture* sense of where the council had already articulated it wants to go. The discussion of existing conditions and trends came out of the work of the technical advisory groups and staff analysis of available data. This discussion, along with primers on water quality and fish and wildlife habitat, formed the base of technical information upon which the council began formulating an Action Plan. The comprehensive list of actions included those taken or proposed by the watershed council, as well as action recommendations by the technical advisors and primer presenters. In addition to these materials, council partners were also asked to review studies their organization or agency has prepared and come to the session ready to suggest actions to include in the Action Plan.

A. Brainstormed List of Actions

Public Outreach, Education, and Information

- Watchable Botany Site in the Coburg hills adjacent to a well traveled road (site has over 200 species of plants, but needs trail construction and interpretive signs)
- Participate in local community events
- MWC newsletter
- Future opportunity for the council involvement in public education and display at the Leaburg Fish Hatchery
- Encourage riparian corridor and floodplain education programs
    - Landowner workshops on riparian management

  - Expand Lane County pamphlet on riparian management
  - Provide pamphlet to home buyers in riparian zones
  - Coordinate, promote and recruit people to make presentations to residents groups about riparian vegetation rules
- Work in conjunction with the appropriate agencies to establish educational or technical assistance programs for farmers and rural homeowners in the watershed study area
- Make McKenzie watershed video and compare it with unhealthy watersheds – include functions and values
- More involvement with schools
  - Speakers bureau for school classes
  - Hands-on projects
- Raise the "sense of the river" through literature, songs, poems, etc.
- Field trips for citizens in the watershed
- Compilation of successes by MWC acting as a forum and the positive contribution this has made in the watershed

Incentives

- Brainstorm and promote incentives for prevention and habitat restoration
- Provide an atmosphere (incentives) to encourage landowners to undertake restoration projects
  - Tax incentives
  - Permit system enhancement
  - Provide facilitation service between landowners
  - One-stop shopping (technical assistance)
  - Create award system for landowners, industrial foresters, etc.
- Educate landowners on incentives for maintaining and restoring riparian

Monitoring, Research, Data Collection, and Evaluation

- Establish monitoring sites on lower river
- Establish an efficient monitoring system including citizen monitoring
- Evaluate different maintenance techniques for all roads to minimize impacts on McKenzie

Water Quality

- Develop and implement a monitoring program to track water quality in the basin
  - Coordinate with water quality data collection entities to continue sampling at sites with long-term information legacies
  - Coordinate with recruited data collection entities to agree on a common monitoring protocol, monitoring network, quality assurance program, and data storage and analysis system for ongoing water quality monitoring
  - Add water quality monitoring data to the McKenzie GIS database to facilitate tracking and analysis
  - Track water quality indicators utilizing the McKenzie GIS database to facilitate temporal and spatial analyses
  - Recruit citizens, school groups, organizations, private industry and agencies to participate in a water quality monitoring program

- Focus on monitoring water quality and keeping areas clean through an Adopt-a-River Program (focus on Mohawk River first)
- Use volunteer monitors to help identify and prevent abuses that recreational activities have on water quality
- Monitor the scope and effectiveness of the IPM programs, independently or in conjunction with other agencies
- Request that Lane County-OSU expand nitrate testing into McKenzie

- Analyze historical data on water chemistry, stream flow, and aquatic communities (specifically macroinvertebrates and algae), to the extent possible, to determine baseline conditions, trends, data gaps, and problem areas for the McKenzie River and its tributaries
- Assemble a team to develop indicators which will be effective in monitoring potential threats to water quality
- Examine the results of ongoing water quality studies to determine whether agricultural impacts on surface water quality in the McKenzie River are increasing or decreasing in response to evolving management standards
- Evaluate whether certain modification to equipment or operations at dams, powerhouses, and fish hatcheries could reduce the potential for adverse water quality impact associated with their operations
- Examine the results of several ongoing studies to determine whether forest practice impacts on surface water quality in the basin are increasing or decreasing in light of evolving management standards
- Determine a reliable estimate for time-of-travel from various points on the McKenzie River to the Hayden Bridge intake
- In conjunction with DEQ, boating and fishing groups, etc., develop data from the McKenzie River and elsewhere in Oregon that would illustrate impacts to water quality from recreational use
- Examine the results of water quality studies currently underway to determine whether impacts on surface water quality in the McKenzie River from roadside vegetation management are increasing or decreasing in light of evolving practices
- Evaluate engineering options for reducing the potential for urban stormwater impact on the drinking water supply
- Evaluate stormwater and septic tank impacts on water quality of lower river
- Investigate solutions for nonpoint source pollution
- Identify catastrophic threats to water quality

Fish and Wildlife Habitat

- Develop and implement a monitoring program to track habitat health
  - Salmon Watch program
  - Monitor wildlife on BLM land
  - Monitor down-cutting caused by dams
  - Monitor riprapping projects particularly along the main-stem
  - Monitor projects on public and private lands for plan compliance
  - Annually assess the status of special habitats and review net losses and determine reasons for loss
  - Formalize use of satellite imagery and guilding class process
  - Analyze secondary channels on the main-stem to determine if they are becoming more iso-

lated

- Establish and assess the current baseline conditions for various parameters affecting fish and wildlife habitat
- Running watershed through Bradbury process (instream actions – priorities on restoration)

Protection, Enhancement, or Restoration Projects

- Erosion control project at Hendricks Wayside (State Parks and Recreation)
- Sponsor replanting of a clear-cut
- Demonstration project for off-stream livestock watering (GWEB $)
- Enhancement of existing ponds on private land (benefits native fish and pond turtles; ODFW supports project and may have funds)
- Site and landowner identified by BLM for riparian restoration and dam/culvert projects
- Demonstration projects with willing property owners on private lands – Assist SWCD in identifying and recruiting private landowners in the McKenzie basin to participate in such projects
- Meadow restoration on BLM land to create a watchable botanical site
- Work with industrial timber companies to undertake restoration projects with volunteers
- Develop resource management plans for demonstration projects in collaboration with participating landowners
- Decommission unnecessary roads
- Identify and correct faulty road culverts
- Identify and preserve key habitat areas:
  - Consider future recruitment of woody debris
  - Focus restoration efforts in the lower main-stem and Mohawk subbasin
  - Urban and agricultural lands are key to consider for restoration
- Continue to develop and implement roadside vegetation management programs for EWEB's roads, canal-banks, and powerline right-of-ways
- Remove man-made barriers to fish passage (e.g., culvert inventory)
- Close Highway 126
- Require barbless hooks
- Restore spring Chinook to Mohawk
- Identify, preserve, and maintain areas on lower McKenzie having high value for habitat and health of watershed
- Reduce pollution sources at river access/recreation sites
- Re-open flood channels
- Restoration activities which expand the current range of Bull Trout in the McKenzie

Advocacy

- Watershed council endorsement list of restoration projects to Province team (FY 95)
- Support funding through Northwest Economic Initiative of the Leaburg fish hatchery
- Encourage development of agricultural practices rules to maintain habitat and water quality
- Encourage federal agencies to complete all watershed analyses and share information
- Push ACOE to consider fish passage at Blue River and Cougar Reservoirs
- Encourage boaters and anglers to practice more care with regard to streambank erosion and waste disposal
- Encourage land use practices that minimize stream sedimentation

- Encourage vegetation management practices that increase growth of vegetation, especially large conifers in riparian corridors
- Encourage improved stream temperature regimes by proper manipulation of flow releases from dams
- Encourage establishment of legal flows on streams important for native fish and wildlife
- Adopt a road closure program during critical periods
- Encourage floodplain restoration programs

Council Review and Comment

- ODOT corridor study (begins January 95 at the earliest)
- McKenzie Communities Implementation Plan (Economic Development plan and vision for the area. Support funding by Forest Service)
- Periodic review (DLCD) of rural and metropolitan comprehensive plans, chance to change riparian and stream setbacks
- SUB's Wellhead Protection Study (opportunity for comment)
- Review management and silviculture practices in riparian areas

Coordination and Cooperation with Projects and Partners

- Volunteer coordination for restoration and monitoring projects on private and federal lands
- Assist landowners in project implementation and provide on-going technical support
- Spill Response
  - Strengthen the spill response and communication network involving EWEB, SUB, and the Rainbow Water District and include a variety of public safety and public works agencies
  - Coordinate with EWEB, SUB and the Rainbow Water District to establish agreed upon response procedures in the event a spill threatens the drink water supply
  - Position trained personnel and/or equipment at selected locations along the river for emergency response to certain types of incidents
  - Periodically test spill response plan
- Continue to take an active interest in ensuring that proper resource management/protection measures and regulations are adequately enforced in the watershed
- Work with other agencies to conduct a comprehensive watershed analysis for the McKenzie River
- Stormwater
  - Encourage DEQ and the City of Springfield to work with business owners in the area to promote better understanding of the stormwater system and more accurate collection of data from permit applications
  - Work with the City of Springfield to accurately identify potential sources of stormwater pollution in the east Springfield area
  - Encourage additional capture of stormwater and other untreated runoff for inclusion with Weyerhaeuser's point-source discharge, located downstream of EWEB's intake
  - Continue to maintain close contact with Weyerhaeuser personnel, and encourage any effort that would reduce the risk to the drinking water supply
- Need more partnerships with research agencies - more information
- Facilitate a yearly conference among land managers within the watershed to review management plans for fish and wildlife

- Sponsorship regular meetings of landowners/managers in the watershed

Forum

- Act as a catalyst/facilitate a study of aggregate resources and possible positive management practices
- Continue to strengthen relationships among partners and McKenzie Valley community groups for a stronger sense of community
- Ask local, state, and federal agencies to share information about issues and activities in the watershed
- Identify conflicting uses - bring parties together to resolve

B. Action Evaluation and Priority Criteria

The list generated at the April work session served as an additional source from which the council chose priority actions. The council also developed possible criteria to be used in evaluating proposed actions and determining their priority in the Action Plan. Criteria developed were as follows:

1) Consistency with the council's mission, goals, and objectives
2) Consistency with the council's program objectives for water quality or fish and wildlife habitat
3) Need
    - Critical nature of existing conditions
    - Degree of risk if action is not taken
    - No one else is doing it
4) Cost of implementing the action
    - Cost effectiveness
    - Cooperation to avoid duplication of efforts
5) Capability to carry out the action
    - Technical expertise
    - Sponsors
    - Labor and staffing
    - Funding
    - Public support
6) Effectiveness of the action
    - Likelihood of success
    - Potential to serve as a model or demonstration project
    - Significance in relation to other actions or the larger effort
    - Enhances scope of existing project
    - Builds community
7) Community benefits
    - Public visibility
    - Opportunities to learn from the project
    - Public education opportunities
8) Timeliness
    - Takes advantage of a window of opportunity
    - Willing landowners

C. Priority Action Selection Process

The council began the task of prioritizing actions at their May 1995 council meeting. Prior to the meeting, each partner was asked to list five actions that they felt the council should set as its highest priority in the next 1½ to 2 years, indicating the reasoning for their selections. Partners were also asked to indicate all the objectives under each of the five goals (water quality, water quantity, riparian and floodplain, instream habitat, and uplands) that will be met as a result of implementing that action. Each partner listed each of their five priority actions on note cards and then posted them under the appropriate category heading on the wall (See Appendix E). After council partners had an opportunity to reviewed the list of prioritized actions, each partner explained to the full council their reasoning behind their highest priority action.

The council referred the next refinement of work on priority actions to an ad hoc council subcommittee. Compiling results from the council's prioritization exercise and further refining the list of priority actions, (See Appendix G) was the subcommittee's charge. The subcommittee identified four priority categories of actions, with four to six actions in each category. Four general categories received the most support in the council's May exercise, receiving more priority actions than the other categories.

The council reviewed the subcommittee's proposal at their June 8t meeting. By consensus, the council agreed to adopt the four primary categories: 1) monitoring and evaluation, 2) education and public outreach, 3) demonstration and restoration projects, and 4) coordination and cooperation. The council expressed concerns about some of the other action proposals and made suggestions to the subcommittee for reworking.

The subcommittee came back at the July meeting with recommendations for the two highest priority actions and a revised list of other priority actions. The two highest priorities include: 1) *assess water quality conditions watershed-wide*, and 2) *develop and encourage restoration, enhancement,; and conservation demonstration projects for priority sites on private lands in cooperation with willing landowners*. The subcommittee identified these two actions as top priority because they received the highest rankings during the May 11 council prioritization exercise. These two actions where fleshed-out and included: background discussion, list of tasks, possible lead/sponsor, necessary resources, and an estimated time frame. The council agreed by consensus to adopt the top two priority actions.

The council also agreed by consensus to adopt the proposed priority actions list as revised (see below). The proposed priority actions list was then used to solicit feedback from community leaders and the public.

III. Council's Proposed Priority Actions (Approved by consensus July 13, 1995)

A. Monitoring and Evaluation: The council expressed some concerns about the other action proposals and made some suggestions to the subcommittee for reworking.

1. Assess water quality conditions watershed-wide.

- Develop and implement water quality monitoring program, involving citizens where appropriate.
- Evaluate data to determine water quality conditions.

2. Assess fish and wildlife habitat conditions watershed-wide.

    - Assess conditions using satellite imagery and other available tools and information.
    - Develop and implement a fish and wildlife habitat monitoring program, involving citizens where appropriate.
    - Evaluate data to determine fish and wildlife habitat conditions and potential threats to vulnerable habitat types.

3. Monitor effectiveness of demonstration projects and other council actions.

B. Education and Public Outreach

1. Develop and support educational programs that foster the protection of high-quality riparian and floodplain corridors.

    - Sponsor field trips and workshops.
    - Develop videos and brochures.
    - Support ongoing programs such as Salmon Watch.

2. Recruit citizens, school groups, organizations, private industries, and public agencies to provide resources and volunteers for monitoring and demonstration projects.

3. Produce an annual *State of the Watershed* report summarizing current conditions in the watershed.

4. Hold an annual conference to update stakeholders and other interested parties on the state of the watershed and council activities.

5. Increase public awareness of council efforts through:

    - The production of council newsletters and videos; and
    - Increased media coverage.

6. Continue to support an education center at the old Leaburg fish hatchery site.

C. Restoration, Enhancement, and Conservation Demonstration Projects

1. Request that the Fish and Wildlife Habitat Task Group identify candidate sites for restoration, enhancement, and conservation projects based on:

    - A watershed-wide assessment (e.g., modified *Bradbury/Division of State Lands Stage I Watershed Assessment*) to identify and prioritize instream and riparian demonstration projects.

- The *Habscape Model* (guilding analysis) to identify and prioritize upland demonstration projects.

2. Develop and encourage demonstration projects for priority sites:

   - On private lands in cooperation with willing landowners, and
   - In riparian and upland habitats.

3. Identify and reduce administrative and regulatory barriers that discourage rehabilitation projects.

D. Coordination and Cooperation

1. Develop incentive programs that:

   - Encourage private landowners and community participation in demonstration projects.
   - Encourage private landowners to take the initiative in implementing conservation practices on their land.

2. Facilitate and coordinate efforts to identify and correct threats in the McKenzie watershed posed by non-point source runoff (e.g., urban stormwater, septic systems, agriculture, logging roads, etc.).

3. Compile and maintain watershed analyses and geographic data bases for the McKenzie watershed.

4. Encourage public agencies and private entities to develop a joint newsletter to keep all stakeholders informed on activities in the watershed.

5. Provide a forum to share information and concerns affecting the watershed.

As a result of input received during public review of the draft Action Plan, three additional priority action clusters were incorporated into the final Action Plan: 1) *develop and implement a broad-based information and education program focusing on water quality practices and riparian areas*; 2) *develop and implement a broad-based incentive program that promotes stewardship in the McKenzie watershed*; and 3) *assess fish and wildlife habitat conditions watershed-wide*. Like the two previously adopted priority action clusters, these action clusters were fleshed-out in more detail. The council's five priority action clusters are explained in detail in the council's Action Plan.

Chapter Six

Monitoring, Evaluation, and Implementation

I. Introduction

This chapter provides the framework and additional technical background used in developing the council's water quality and fish and wildlife monitoring strategy. The components discussed in this chapter only summarize the work and recommendations of the technical advisors and do not cover the photo documentation or citizen monitoring aspects of the overall monitoring strategy.

The section on the benchmark system describes preliminary recommendations of the Water Quality and Fish and Wildlife Habitat task groups to the watershed council to monitor watershed health and evaluate the effectiveness of council actions. This discussion also includes recommendations for interim benchmarks for water quality, water quantity, aquatic communities and fish and wildlife habitat. These benchmarks will need refinement before adoption by the council.

Finally, the chapter provides the technical background and analysis used in the development of the watershed-wide water quality monitoring program and wildlife habitat assessment.

II. Monitoring Strategy

A. Benchmark System

With the help of a team of technical advisors, the council is working to develop a system of *benchmarks*, which will assist the council in evaluating the effectiveness of its actions. Simply put, the benchmark system is a mechanism to help quantitatively measure and track progress towards achieving the desired conditions expressed in the council's water quality and fish and wildlife habitat goals and objectives. Benchmarks provide a means of expressing council-desired conditions for the McKenzie watershed in specific, sustainable terms and allow the council to measure its progress toward achieving its goals.

The benchmark system consists of the following components:

1. Goal: statement of desired conditions.
2. Indicator: units of measurement that tell the council what to measure, and where and when to measure it.
3. Measurement: the actual data collected for a indicator.
4. Benchmark: a specific value for an indicator set at a particular future point in time that shows progress towards reaching the desired condition (i.e., target). Benchmarks can be considered as mileposts along the way toward achieving the desired condition.
5. Target: a benchmark (i.e., quantifiable goal) set at the end of a specified planning period.

Monitoring progress towards these benchmarks will help the council learn more about the health of the McKenzie River and tributaries. This knowledge in turn will help council partners make informed decisions and set rational priorities for action implementation. It will also aid the council in determining how the watershed is responding to actions or if it is not responding at all.

The council considers these benchmarks as:

- Reference points for goal setting,
- Tools for setting priorities and allocating resources for partners' budgets and volunteers,
- Yardsticks for measuring watershed health and council performance,
- Tools for seeking partner cooperation on broad issues,
- Tools for assessing the gap between existing and desired conditions, and
- Learning and educational tools.

Because a system of benchmarks can serve a variety of purposes, the form they take will vary. However, emphasis is placed on measuring results rather than effort (e.g., x acres of low-quality riparian areas rehabilitated, as opposed to x dollars spent on rehabilitating low-quality riparian habitat).

Targets and benchmarks will be developed for water quality and fish and wildlife habitat. For example, the targets for water quality may be that by the year 2010, 100 percent of the water quality data at specific monitoring points in the watershed surpass state standards or baseline conditions for parameters where state standards do not exist. In some instances it is very difficult to set benchmarks and realistic targets until more is learned about the existing conditions in the watershed. Consequently, targets and benchmarks may need refinement over time as the council learns more about the watershed.

B. Draft Benchmark Recommendations

The following draft interim benchmark proposals were put forth by a group of water quality technical advisors and presented to the council in November 1994. In some instances it is very difficult to set benchmarks and realistic targets until more is learned about the existing conditions in the watershed. Consequently, targets and benchmarks will need refinement over time as the council learns more about the conditions in the McKenzie watershed.

1. Water Quality

Goal: Maintain and enhance existing high water quality of the McKenzie River, tributaries, and underlying groundwater for drinking water, fish and wildlife habitat, water contact recreation, industry, and aesthetics.

Primary Indicators: (parameters for which instream DEQ standards exist for the McKenzie watershed)

a) Dissolved Oxygen: Year round, headwaters to the confluence with the Willamette
b) E. Coli Bacteria: Year round, headwaters to confluence
c) Temperature: Year round, headwaters to confluence
d) pH: Year round, headwaters to confluence
e) Toxic substances: Year round, at the confluence of the McKenzie with the Willamette

f) Total Dissolved Solids: Year round, headwaters to the confluence
g) Turbidity: Year round, above and below selected tributaries and selected activities

Secondary Indicators: (parameters for which DEQ standards do not exist, but are important indicators of water quality for the McKenzie watershed)

a) Nutrients (total nitrogen; dissolved ammonia; dissolved nitrite plus nitrate, total phosphorus, dissolved phosphorus): Year round, headwaters to the confluence
b) Chemical Oxygen Demand (COD): Year round, headwaters to the confluence
c) Biochemical Oxygen Demand (5-day BOD): Year round, headwaters to the confluence
d) Color: Year round, headwaters to the confluence
e) Settleable Solids: Year round, headwaters to the confluence
f) Total Suspended Solids: Year round, headwaters to the confluence

Measurements: Sample collection: location and date of sample collection, indicator, and results.

Interim Benchmarks: *Table 14* presents the interim benchmarks for primary water quality indicators and *Table 15* shows secondary water quality indicators. These benchmarks assume that water quality currently surpasses state standards. The values for the years 2000 and 2005 will be established once baseline conditions have been determined. If analyses demonstrate that water quality for any of these indicators does not meet state standards, than the benchmarks should be established to demonstrate progressive improvement over time.

Table 14
Interim Benchmarks for Primary Water Quality Indicators

Primary Indicator	State Standard or Baseline	Benchmark Percent of Sites Surpassing Standard or Baseline by 2000	Benchmark Percent of Sites Surpassing Standard or Baseline by 2005	Target Percent of Sites Surpassing Standard or Baseline by 2010
DO	Not <90% saturation at seasonal low or <95% saturation in spawning areas during spring incubation, hatching, and fry stages of salmonids (standard being revised)	X	Y	100%
E. Coli	Standard being developed	X	Y	100%
Temperature	Standard being revised	X	Y	100%
pH	6.5-8.5	X	Y	100%
Toxic Substances	varies	X	Y	100%
Total Dissolved Solids	100 mg/l	X	Y	100%

Note: X and Y values will be established once baseline conditions have been determined.

Table 15
Interim Benchmarks for Secondary Water Quality Indicators

Secondary Indicator	Baseline	Benchmark Percent of Sites Surpassing Standard or Baseline by 2000	Benchmark Percent of Sites Surpassing Standard or Baseline by 2005	Target Percent of Sites Surpassing Standard of Baseline by 2010
Nutrients: -Total N_2 -Dissolved NH_3 -Dissolved NO_3 + NO_2 -Total Phosphorus -Dissolved Phosphorus	To be determined	X	Y	100%
COD	To be determined	X	Y	100%
BOD	To be determined	X	Y	100%
Color	To be determined	X	Y	100%
Total Suspended Solids	To be determined	X	Y	100%

Note: X and Y values will be established once baseline conditions have been determined.

Targets: By the year 2010, 100 percent of the monitoring sites surpass state instream standards for the primary indicators and 100 percent of the monitoring sites maintain or surpass baseline conditions for secondary indicators.

2. *Water Quantity*

Goal: Ensure adequate stream flows exists in the McKenzie River and tributaries to meet instream and out-of-stream water uses (e.g., aquatic habitat, recreation, pollution dilution, irrigation, industry, hydroelectric power, etc.).

Indicator: Volume per unit of time at selected sites for every month compared with instream flow needs.

Measurements: Flow measurement: location, date, and results of flow measurement.

Interim Benchmarks: *Table 16* displays interim benchmarks for water quantity.

Table 16
Interim Water Quantity Benchmarks

Time Frame	**Benchmark Percent of River Meeting Instream Flow Needs by 2000**	**Benchmark Percent of River Meeting Instream Flow Needs by 2005**	**Target Percent of River Meeting Instream Flow Needs by 2010**
12 Months of the Year	X	Y	100%

Note: X and Y values will be established once baseline conditions have been determined.

Target: Through the year 2010, 100 percent of the McKenzie River and its major tributaries with minimum stream flows meet instream flow needs.

3. Aquatic Communities

Goal: Aquatic communities species indicative of high-quality water will be maintained.

Indicators:

a) Macroinvertebrates collected at sampling pints from the headwaters to the confluence of the McKenzie River, including sites that reflect significant changes in flow or at the confluence of different water sources, at various times of the year.
b) Periphyton algae samples collected at sites from the headwaters to the confluence.

Measurements:

a) Macroinvertebrate sample collection: location and date of sample collection, macroinvertebrate species, and results.
b) Salmon redd counts: location and date of salmon redd counts.
c) Periphyton algae: location and date of sample collection; results.

Interim Benchmarks:

Benchmark Percent of Sites Showing Healthy Biotic Index in 2000	**Benchmark Percent of Sites Showing Healthy Biotic Index in 2005**	**Benchmark Percent of Sites Showing Healthy Biotic Index in 2010**
X	Y	100%

Benchmark Percent of Sites Showing Healthy Biotic Index in 2000	**Benchmark Percent of Sites Showing Healthy Biotic Index in 2005**	**Benchmark Percent of Sites Showing Healthy Biotic Index in 2010**
100%	100%	100%

Note: X and Y values will be established once baseline conditions have been determined.

Targets:

a) By the year 2010, 100 percent of the sites sampled will exhibit macroinvertebrate abundance and diversity indicative of excellent water quality.
b) Periphyton algae levels will exhibit abundance and diversity indicative of excellent water quality.

Council review of the draft benchmark scheme raised several issues:

1. Although the technical advisors recommended indicators and targets for water quality, quantity, and aquatic communities, insufficient information on baseline conditions prevented them from making benchmark recommendations.
2. Questions regarding monitoring logistics and sampling strategies to track indicators.

To begin addressing these issues, council directed staff to work with the technical advisors to develop a water-quality monitoring strategy for the watershed. Development and implementation of a watershed-wide monitoring program would identify baseline conditions, making it possible for the council to establish benchmarks and use them as mileposts in evaluating its progress towards achieving its goals.

C. Draft Benchmarks for Fish and Wildlife

Fish and wildlife habitat benchmarks were developed under the direction of the watershed council by the Fish and Wildlife Task Group. The benchmarks are focused around three broad topic areas: Watershed Function, Biodiversity and Fish and Wildlife Habitat Interactions. The benchmarks represent a range of types from those designed to track individual species to those used to assess various components of watershed function and human influences. These benchmarks are meant to be used as tools to assess current and track future watershed health, learn about the watershed and describe the condition of the watershed. The benchmarks will also be useful to provide a method for identifying areas to focus resources and on-the-ground efforts.

1. Watershed Function

Watershed function includes those physical and biological processes and interactions that naturally occur within watersheds. These processes include upland, riparian, aquatic habitat, structure and composition, hydrologic processes, sediment production and transport, and connectivity of rivers to their floodplain. The natural function and structure of the McKenzie watershed has been altered by highway and dam construction and the exclusion of fire. Past management activities such as vegetation removal and road building may have caused changes in the hydrologic response of the watershed, altered riparian function and diversity, and changed the amount of sediment that is produced and routed through the system.

Goal: Maintain and/or rehabilitate where practicable, natural function and structure of the watershed to protect fish and wildlife habitat.

Indicators: Indicators were selected to track trends watershed-wide among various watershed function variables. Indicators include:

a. Vegetation seral stage - distribution and age of vegetation types
b. Riparian Vegetation - distribution, age, and quality
c. Sediment production/routing - measurement to be determined
d. Large woody debris - quantity and distribution
e. Pool- riffle ratio - distribution per stream segment
f. Connectivity - measurement to be determined

2. *Biodiversity*

Biodiversity is defined as *the variety of life forms and processes, including a complexity of species, communities, gene pools, and ecological functions* (FEMAT). The McKenzie Watershed Council biodiversity goal emphasizes native habitat maintenance and rehabilitation, but is not intended to exclude harmless non-indigenous species. Biodiversity, as measured by the occurrence of indigenous species in an area, is considered a good measure of habitat health and can be a useful tool in tracking the quality of fish and wildlife habitat in the watershed.

***Goal*:** Maintain and/or rehabilitate habitats to protect biodiversity, with emphasis on habitats of fish and wildlife native to the watershed.

Indicators: Two approaches are recommended for tracking biodiversity. The first approach assesses habitat at the landscape scale (guilding process), while the second approach uses an “indicator species” approach. Each serves as a check to the other in evaluating habitat health in the watershed. Indicators for biodiversity include:

a. Watershed-wide assessment - habitat conditions and distribution for all terrestrial species suspected to occur in the watershed and ranking the conditions for each.
b. Riparian and forest indicator species

- Number of Bald Eagle nesting sites in the watershed
- Number of Osprey nesting sites in the watershed
- Number of Peregrine Falcon nesting sites in the watershed

c. Older forest structure - indicated by the distribution of Pine Martens, spotted owl, and pileated woodpecker in the upper portions of the watershed.

d. Stream and Riparian -
   - Distribution of Harlequin ducks
   - Distribution of tailed frogs in second ordered and above streams
   - Distribution and number of bull trout in third order streams upriver from Leaburg Dam
   - Distribution and number of cutthroat trout in second, third, and fourth order streams

e. Meadows and early successional forests
   - Black tail deer trend counts and harvest data.
   - Great gray owl nesting success

f. Lower Watershed
   - Number of Heron rookeries found in the lower portion of the watershed

g. Upper forest
   - Distribution of slender salamanders in the upper portions of the watershed
   - Distribution of cascade salamanders in first order streams

h. Wet meadows (wilderness) - sandhill crane nesting

3. Human, Fish, and Wildlife Interactions

Concerns related to increasing development activities within fish and wildlife habitat areas of the McKenzie watershed include: residential, commercial, and industrial development within the floodplain; forest and agricultural management practices; road building; and increasing water demands. Where possible, a maintenance approach is emphasized, or where possible, improvement on the effects human activities have on fish and wildlife populations and their habitat.

Goal: Maintain or improve fish and wildlife populations and their habitat by minimizing the deleterious effects of human influences.

Indicators: The following indicators are recommended for tracking the efforts of the McKenzie Watershed Council towards attaining the desired condition expressed in the goal statement. Selected indicators measure the results of human activities on the health of fish and wildlife populations and their habitat. Indicator categories include:

a. Riparian Vegetation
   - Increase the percentage of mature conifers within the riparian corridor
   - Decrease the percentage of unvegetated riparian corridor

b. Stream habitat
   - Increase the number of pools
   - Large woody debris
   - Decrease the amount of fine sediments in steams
   - Increase the amount of course sediments below the dams
   - Restore normal stream temperature regimes

c. Stream flows
   - Maintain legal minimum stream flows within the watershed for which minimum

stream flows have been established by OWD.

- Maintain stream flows adequate to support existing or increased populations of native fish and wildlife on all remaining streams within the watershed for which minimum stream flows have not been established.

d. Road density

- Maintain or decrease road density in agriculture and forest lands
- Minimized increases in road density in D & C areas (non-resource lands)
- Decreased number of migration barriers (culverts).

e. Floodplain development

- Reduced number of structures allowed within the floodplain
- Minimized impacts of new structures placed within the floodplain through improved siting requirements
- Increased amount of vegetation within the floodplain
- Reduced negative impacts of floodplain aggregate removal
- Decreased rip-rap bank stabilization projects and increased vegetation bank stabilization methods
- The Fish and Wildlife Task Group also developed a list of recommended actions for dams and diversions. This list is contained in Appendix H.

D. Water Quality Monitoring

In March 1995, at direction from the council, a technical advisory committee made up of scientists and engineers began developing a water-quality monitoring program for the McKenzie watershed. The monitoring program is intended to assist the council in evaluating progress towards meeting their water quality targets (one measure of watershed health).

The objectives of the water quality monitoring program are to:

1. Monitor the overall health of the McKenzie River.
2. Determine if and how the water quality of the McKenzie River is changing over time, accounting for natural and seasonal variation.
   a. Determine spatial distribution of water quality conditions throughout the basin.
   b. Determine temporal variability, both short- and long-term, of water quality conditions.
3. Provide credible data upon which management decisions can be made.
4. Provide an affordable and sustainable measurement tool to evaluate the effectiveness of action steps taken to protect/enhance the water quality of the McKenzie River.
5. Provide an early warning system to signal if any adverse trends are developing.
6. Utilize historical data, as much as practicable, to develop longer trends.

The water-quality monitoring program recommended by the technical advisory committee incorporates three separate approaches, referred to as tiers.

> Tier I. This is the ambient monitoring component of the water-quality program requiring long-term sampling at fixed intervals at fixed locations. This approach is suited for monitoring the overall condition of the river system, determining long-term water quality trends and detecting the general areas of the watershed that may be the sources of water quality problems.

Tier II. The focus of this component is monitoring high flow storm events at all Tier I monitoring sites. Monitoring high flow events is considered important since storms can flush large volumes of pollutants into streams.

Tier III. This element of the monitoring program (synoptic sampling) will serve various functions. It will be used to pinpoint or quantify the sources of any adverse trends which are uncovered through the Tier I trends monitoring. Synoptic sampling can also serve other information needs such as monitoring during periods of special concerns (e.g., low flow, pesticides during spring runoff, etc.) and evaluating the effectiveness of a particular project. Synoptic sampling can be a ideal means of collecting a “snapshot” of baseline water-quality conditions throughout the watershed and is ideal for some constituents which require data from many sites, but only a few samples per site. The Water Quality Monitoring Technical Advisory Committee felt volunteers could be effectively used for Tier III sampling.

Candidate Tier I water-quality monitoring sites were screened and are shown in *Table 17*. Many of these sites were selected for on-the-ground evaluation. The evaluation of the initial 16 site visits appear in *Table 18* (several others were later visited).

Table 17
Candidate Water Quality Monitoring Sites

Site Location

McKenzie main-stem at Coburg Road Bridge, near Armitage State Park
McKenzie main-stem, downstream of Mohawk-McKenzie confluence (Rodakowski Landing - *not a river crossing*)
Lower Mohawk at Hill Road
Alternate – lower Mohawk at Marcola Road
Alternate – lower Mohawk at Sunderman Road
Alternate – lower Mohawk (*crossing may not exist*)
McKenzie main-stem at Hayden Bridge, downstream of urbanizing east Springfield
McKenzie main-stem at Hendricks Bridge
McKenzie main-stem, Deerhorn Park (west of Leaburg) – geomorphology changes, rural residential
McKenzie main-stem near Vida (USGS discharge station, 5.4 miles east of Vida)
McKenzie main-stem at Goodpasture Covered Bridge, downstream of Gate Creek-McKenzie confluence near Vida
Gate Creek at Hwy. 126
Alternate – North Fork Gate Creek off Gate Creek Road
Alternate – South Fork Gate Creek off Gate Creek Road
McKenzie main-stem, Nimrod (Rosboro) Landing – downstream of Quartz Creek-McKenzie confluence west of Finn Rock
Quartz Creek at Pond Road (USFS Rd. 305)
Alternate – Quartz Creek at USFS Rd. 314 (off of USFS Rd. 2618)
Blue River near confluence with McKenzie (at Blue River Drive)
South Fork McKenzie at USFS Rd. 19 (Aufderheide Drive), between confluence with McKenzie and Cougar Dam
South Fork McKenzie at USGS discharge station 0.6 miles downstream of Cougar Dam
McKenzie main-stem at Belknap Covered Bridge, downstream of Horse Creek-McKenzie confluence
Horse Creek, West Fork, near confluence with McKenzie
Alternate – Horse Creek (*road out? Delta Dr.? – crossing may no longer exist*)
Alternate – Horse Creek at USFS Rd. 2638 (Horse Creek Road)
McKenzie main-stem near McKenzie Bridge (USGS discharge station, 1.7 miles east of the town of McKenzie Bridge)
Alternate – White Branch (Lost Creek) (*Yale Lane off of Hwy. 242? – crossing may not exist*)
Alternate – White Branch at Hwy. 242
McKenzie main-stem at USFS Rd. 2654, near Deer Creek-McKenzie confluence
Deer Creek at USFS Rd. 2654, above Deer Creek-McKenzie confluence
Deer Creek, above Deer Creek-McKenzie confluence (*off USFS Rd. 2654? – crossing may not exist*)
McKenzie main-stem downstream near Clear Lake outlet (USGS discharge station)
Alternate - McKenzie main-stem near Koosah Falls

Table18
Initial Site Visits – Candidate Water Quality Monitoring Sites

Site Location	Purpose	Characterization	Safety	Limitations
Lower Mohawk at Hill Road	Major tributary; drains agricultural lands; strong potential for land use changes; active USGS discharge station 50 ft. down-stream from bridge (cable)	Agricultural; rural residential; pasture; riparian fringe exists; mean annual flow - 524 cfs	Good, 3' shoulder with white line, guard rail; safety factors associated with cable car if utilized	Storm runoff drains are on downstream side of bridge
McKenzie at Hayden Bridge	Main-stem site; EWEB drinking water intake; downstream of urbanizing east Spring-field; water quality monitoring for some parameters exists at site	Convenience Store; agricultural and rural residential; indus-trial; EWEB intake; riparian strip intact	Excellent, railed side-walk on both sides of the bridge	
McKenzie, Deerhorn Park	Main-stem site; geomorphology changes – valley widens; rural residential influences	Rural residential, small county park on south bank; boat landing downstream; golf course downstream 250'+; riparian fringe exists upstream; riparian fringe limited to none immediately downstream	Fair, one-lane bridge; no white line or pedes-trian lane; guard rail	River upstream is flat and wide, but becomes constricted immediately upstream from bridge to accomodate structure
Gate Creek at Hwy. 126	Tributary site; private forestry influences; inactive discharge station	Rural residential; private forest lands upstream; riparian fringe; mean annual flow - 214 cfs	Execellent on upstream side, metal guard rail and concrete abutment flank pedestrian cross-ing; poor safety on downstream side – white line, but unprotected from busy highway	Unsafe from downstream side of bridge
North Fork Gate Creek	Tributary site; private forestry influences	Private forest lands; young second growth (10 yr. old trees); riparian fringe; fast water; scoured stream bed down to bedrock it appears	Good, lightly traveled road; guard rail; white line marks narrow pedestrian crossing; potential log truck traffice	Potential log truck traffic
South Fork Gate Creek	Tributary site; private forestry influences	Private forest lands; pasture	Good, need to climb over locked gate	Private bridge marked "no trespassing,"
McKenzie, Nimrod Landing	Mid-basin, main-stem integrator site	Private forest lands; riparian fringe; rural residential; flat, fast moving river	Excellent	

Table 18 Continued
Initial Site Visits – Candidate Water Quality Monitoring Sites

Site Location	Purpose	Characterization	Safety	Limitations
Quartz Creek at Pond Road	Tributary site; private forestry influences; inactive discharge station (?)	Private forest lands; riparian fringe; fast moving, turbulent water; mean annual	Single lane bridge; guard rail; no pedestrian walkway, but visibility is good	Potential log truck traffic
Quartz Creek at USFS Road 314	Tributary site; private forestry influences	Private forest lands; riparian fringe; fast moving water; large rock visible (1-2” in diameter)	Fair to good, wooden bridge; 1’ high, wood guard rail	Potential log truck traffic
Blue River at Blue River Drive	Major tributary; dam and reservoir influences; ACOE temp. control project; active USGS discharge station (?)	Rural residential; riparian fring; downstream from Blue River Reservoir; mean annual flow - 449 cfs	Good, concrete guard rail - painted white; pedestrian walkway	
S. Fork McKenzie at USFS Road 19	Major tributary; dam and reservoir influences; ACOE temp.	Downstream from Cougar Reservoir	Fair, blind corner traveling north; narrow elevated pedestrian walkway on upstream side of bridge; white line on downstream side; guard rail; high traffic area	Can high center vehicle with low ground clearance getting in and out of parking area; high traffic area
S. Fork McKenzie at gaging station	Major tributary; dam and reservoir influences; ACOE temp. control project; active USGS discharge station (cable)	Downstream from Cougar Reservoir; mean annual flow - 846 cfs	Safety factors associated with cable car if utilized	
Horse Creek at USFS Road 2638	Major tributary; National Forest lands; inactive USGS monitoring site (temp. data)	Public forest lands; diverse riparian fringe (hard and softwoods); good water flow – flat; mean annual flow - 504 cfs	Good; 4’ pedestrian walkway; striped in white; concrete guard rail; light traffic	
White Branch at Hwy. 126	Upper watershed tributary; National Forest lands	Public forest lands	Very poor; 1’ pedestrian walkway; no striping; along busy highway	Unsafe for sampling; adjacent to unprotected busy highway
White Branch at Yale Lane	Upper watershed tributary; National Forest lands; inactive USGS monitoring site (temp. data)	Public forest lands; mean annual flow - estimated at 300 cfs	Hazardous, collapsed bridge	Bridge collapsed
White Branch at at Hwy. 242	Upper watershed tributary; National Forest lands	Public forest lands	No shoulder along narrow highway	Culverted; about 2.5 miles off Hwy. 126; safety (narrow road, no shoulder)

Criteria for site selection included: anticipated land use changes in the area, potential to serve as an integrator site reflecting dominate land use, bridge or cable crossing access, safety, and proximity to flow gaging stations. In the end, the technical advisory committee recommended a watershed-wide monitoring network composed of seven fixed monitoring stations along the mainstem McKenzie River and key tributaries (*Table 19 and Map 23 (page 131)*).

Table 19
Tier I Recommended Monitoring Stations

Site	Location	Description
1	McKenzie River @ Coburg Rd. Bridge	Serves as an integrator site, reflecting the cumulative effects of the entire watershed. DEQ has been collecting data at this site since 1975.
2	Mohawk River @ Hill Road	Serves as a major tributary integrator site reflecting the cumulative effects from rural residential, forestry activities on public and private lands, and agricultural uses of the sub-watershed. Strong potential for land use changes exists for this sub-watershed over the next 20 years due to urbanization
3	McKenzie River @ Hendricks Bridge	Serves as an integrator site reflecting the impacts of a major water diversion for power generation, rural residential, and agricultural use.
4	Blue River @ Blue River Drive	Serves an indicator site reflecting the effects of Cougar Dam and Reservoir. The Army Corps of Engineers plans to install temperature control facilities at the dam sometime during the next ten years.
5	S. Fork McKenzie River @ USFS Rd. 19	Serves an indicator site reflecting the effects of Blue Rive Dam and Reservoir. The Army Corps of Engineers plans to install temperature control facilities at the dam sometime during the next ten years.
6	McKenzie River @ McKenzie Bridge	Serves as an upstream integrator site reflecting the effects from the upper watershed, including forestry activities on public lands and rural community development.
7	McKenzie River @ Koosah Falls	Serves as a reference site for the upper McKenzie River mainstem where expected changes in water quality over time would most likely reflect changes due to climate or other natural conditions.

Map 23
Water Quality Monitoring Stations

The council accepted the committee's recommendation and is working with the Oregon Department of Environmental Quality (DEQ) to implement Tier I of their water-quality monitoring program. Tier I sampling in the McKenzie watershed began in November 1995. DEQ is collecting data at three sites (Coburg Road, Hendricks Bridge, and McKenzie Bridge) at no charge to the council and the council is contracting with DEQ to monitor the other four sites.
Data will be collected eight times a year (January, February, April, May, July, August, October, and November). Water samples will be analyzed for the same physical, chemical, and biological parameters that are routinely collected and analyzed by DEQ for streams in the Willamette Basin (*Table 20*). This allows for comparisons of the McKenzie's water quality with other streams in the basin. DEQ will provide an annual evaluation and summary of the data to the council. Council partners from the Eugene Water & Electric Board, Springfield Utility Board, and the Army Corps or Engineers have already indicated a willingness to contribute funding for this long-term monitoring effort.

Table 20
Water Quality Sampling Parameters for Tier I Stations

- Alkalinity
- Biochemical Oxygen Demand (BOD)
- Calcium, Dissolved
- Chlorophyll a
- Chemical Oxygen Demand (COD)
- Coliform, Fecal
- Color
- Conductance, Specific
- Enterococcus
- Hardness, Dissolved
- Iron, Dissolved
- Magnesium, Dissolved
- Manganese, Dissolved
- Nitrogen, Ammonia
- Nitrogen, Nitrite plus Nitrate (NO_3 + NO_2)
- Nitrogen, Total Kjeldald Nitrogen (TKN)
- Oxygen, Dissolved
- Oxygen, Percent Saturation
- pH
- Phosphorus, Dissolved Ortho
- Phosphorus, Total
- Potassium. Dissolved
- Sodium, Dissolved
- Solids, Suspended
- Solids, Total
- Stage, Stream
- Temperature
- Total Organic Carbon (TOC)
- Total Organic Halogen (TOX)
- Turbidity
- Aluminum, Dissolved
- Lithium, Dissolved

As described earlier, the focus of Tier II monitoring is to monitor high-flow events since storms flush large volumes of pollutants into streams. The technical advisory committee recommend collecting samples for three high flow storm events at all Tier I monitoring sites. The samples would be analyzed for the same Tier I parameters. As a cost saving measure, high flow samples could be collected for three years, and then stopped for a period of three to six years, and then restarted for a period of three years.

Initial recommendations for synoptic sampling (Tier III) include collecting data on parameters sensitive to diurnal variation (conditions which typically vary throughout the day, trace elements, pesticides, semi volatile compounds, and volatile organic compounds. *Table 21* displays the water quality sampling recommendations for Tier III.

Table 21
Tier III Water Quality Sampling Recommendations

Parameter	Location	Frequency
Dissolved Oxygen (DO)	All Tier I stations	During two summer months, at sunrise and 4 p.m.
PH	All Tier I stations	During two summer months, at sunrise and 4 p.m.
Temperature	All Tier I stations	During two summer months, at sunrise and 4 p.m.
Trace Elements (metals)	Coburg Bridge	Summer low flow, winter storm event, and first flush (fall/winter rains)
Pesticides	Mohawk & Coburg Road	First significant spring storm following pesticide application and first major Fall storm (Oct./Nov.)
Semi Volatile Compounds	Coburg Bridge	Summer low flow, winter storm event, and first flush (fall/winter rains)
Volatile Organic Compounds	Coburg Bridge	Summer low flow, winter storm event, and first flush (fall/winter rains)

Notes: Data for pesticides, trace elements, semi-volatile organic compounds, and volatile organic compounds do not need to be collected annually unless a problem is apparent.

For certain groups of pesticides and semi-volatile organic compounds, it may be more helpful to collect bed-sediment data rather than water-column data.

E. Watershed-Wide Habitat Assessment

As was discussed in detail in Chapter Four, uplands section, a landscape analysis for upland wildlife habitat suitability was conducted for the McKenzie watershed using a habitat suitability model called Habscapes. Habitat is considered a good indicator of species health since tracking individual wildlife species may not immediately show the effect of habitat health.

Assessing the amount and distribution of habitat for all species in the watershed as well as identification of visual gaps or habitat corridors should have been possible. However, a noticeable number of questions in the mapped results led the technicians to believe that some errors still existed in the queries of the vegetation database. Still, significant progress was made during the first attempt at using the Habscapes model and it appears to be a worthwhile concept to pursue further at the watershed-wide level.

The refinements over time will make this model more useful. The model will provide assistance in quantifying habitat suitability throughout the watershed and assist in resolving wildlife management issues. A bi-annual meeting of land managers in the watershed to discuss the results of the model should prove beneficial in itself. Over time, the results of the analysis can be compared and trends identified.

Appendix A

Water Quality Task Group

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Appendix B

McKenzie Watershed Council Fish and Wildlife Habitat Task Group

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Appendix C

Wildlife Species List for the McKenzie Watershed

Code	Species Uses
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
LKRVARML	Lake or River, Using the Aquatic Portion and Terrestrial Riparian Vegetation in the Mid and Late Seral Stages
LKRVARG	Lake or River, Using the Aquatic Portion and Terrestrial Riparian Vegetation Regardless of Seral Stage (Generalist)
LKRVRE	Lake or River, Using the Terrestrial Vegetation Only in the Early Seral Stage
LKRVRML	Lake or River, Using the Terrestrial Vegetation Only in Mid and Late Seral Stages
LKRVRG	Lake or River, Using the Terrestrial Vegetation Only Regardless of Seral Stage (Generalist)
SPCL	Associated With a Special Habitat
TLC	Terrestrial, Large Home Range, Contrast Species
TLGG	Terrestrial, Large Home Range, Generalist Species
TLME	Terrestrial, Large Home Range, Mosaic, Early Seral
TLML	Terrestrial, Large Home Range, Mosaic, Late Seral
TMC	Terrestrial, Medium Home Range, Contrast Species
TMGG	Terrestrial, Medium Home Range, Generalist Species
TMME	Terrestrial, Medium Home Range, Mosaic, Early Seral
TMML	Terrestrial, Medium Home Range, Mosaic, Late Seral
TSC	Terrestrial, Small Home Range, Contrast Species
TSGG	Terrestrial, Small Home Range, Generalist Species
TSGEM	Terrestrial, Small Home Range, Generalist Early/Mid Seral
TSGML	Terrestrial, Small Home Range, Generalist, Mid/Late Seral
TSME	Terrestrial, Small Home Range, Mosaic Early Seral
TSPE	Terrestrial, Small Home Range, Patch Species, Early Seral
TSPL	Terrestrial, Small Home Range, Patch Species, Late Seral

McKenzie Watershed Wildlife Species

Common Name	Guild Name	Special Habitat
American coot	LKRVA	
American wigeon	LKRVA	
Blue-winged teal	LKRVA	
Bonaparte’s gull	LKRVA	
California gull	LKRVA	
Canvasback	LKRVA	
Caspian tern	LKRVA	
Cinnamon teal	LKRVA	
Common loon	LKRVA	
Dunlin	LKRVA	
Eared grebe	LKRVA	
Eurasian wigeon	LKRVA	
Gadwall	LKRVA	
Glaucous-winged gull	LKRVA	
Greater scaup	LKRVA	
Greater white-fronted goose	LKRVA	
Green-winged teal	LKRVA	
Horned grebe	LKRVA	
Leach’s storm petrel	LKRVA	
Lesser scaup	LKRVA	
Northern pintail	LKRVA	
Northern shoveler	LKRVA	
Oldsquaw	LKRVA	
Pacific loon (Arctic)	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 swan (whistling)	LKRVA	
Western grebe	LKRVA	
White-winged scoter	LKRVA	
Canada goose	LKRVARE	
Killdeer	LKRVARE	
Mallard	LKRVARE	
Water vole	LKRVARE	
Western pond turtle	LKRVARE	
Bald eagle	LKRVARG	
Beaver	LKRVARG	
Bullfrog	LKRVARG	

Common egret	LKRVARG	
Double-crested cormorant	LKRVARG	
Dunn’s Salamander	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	
Belted kingfisher	LKRVARML	
Bufflehead	LKRVARML	
Cascade torrent salamander	LKRVARML	
Common goldeneye	LKRVARML	
Common merganser	LKRVARML	
Harlequin duck	LKRVARML	
Hooded merganser	LKRVARML	
Pacific giant salamander	LKRVARML	
Pacific water shrew	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	
Red-eyed vireo	LKRVRML	
White-footed vole	LKRVRML	
Acorn woodpecker	SPCL	
American bittern	SPCL	WETLAND
Barn owl	SPCL	BLDG
Barn swallow	SPCL	LEDGES
Black swift	SPCL	WATER FALL
Bushy-tailed woodrat	SPCL	CAVES,ROCK
Cliff swallow	SPCL	BANKS
Common snipe	SPCL	
Giant Pocket Gopher	SPCL	AGLANDS
Greater yellowlegs	SPCL	

House mouse	SPCL	
Least sandpiper	SPCL	BEACH
Lesser yellowlegs	SPCL	
Long-billed dowitcher	SPCL	
Northern harrier	SPCL	
Northern waterthrush	SPCL	
Pectoral sandpiper	SPCL	
Peregrine falcon	SPCL	CLIFFS
Pika	SPCL	TALUS,LAVA
Prairie falcon	SPCL	CLIFFS
Red-winged blackbird	SPCL	CATTAILS
Rock dove	SPCL	LEDGES
Rock wren	SPCL	ROCK/CLIFF
Rosy finch	SPCL	
Sandhill crane	SPCL	
Semipalmated plover	SPCL	
Short-horned lizard	SPCL	SAND
Solitary sandpiper	SPCL	
Sora	SPCL	
Spotted frog	SPCL	WETMEADOW
Spotted sandpiper	SPCL	
Townsend’s big-eared bat	SPCL	CAVES
Virginia rail	SPCL	
White-headed woodpecker	SPCL	
Yellow-bellied marmot	SPCL	ROCK PILE
Boreal owl	TLC	
Elk	TLC	
Golden eagle	TLC	
Great gray owl	TLC	
Great horned owl	TLC	
Red-tailed hawk	TLC	
Turkey vulture	TLC	
American crow	TLGG	
Black bear	TLGG	
Bobcat	TLGG	
Common raven	TLGG	
Coyote	TLGG	
Gray fox	TLGG	
Gray wolf	TLGG	
Lynx	TLGG	
Mountain lion	TLGG	
Wolverine	TLGG	
Red fox	TLME	
Rough-legged hawk	TLME	
Swainson’s hawk	TLME	
Barred owl	TLML	
Fisher	TLML	

Marten	TLML
Northern goshawk	TLML
Northern spotted owl	TLML
Pileated woodpecker	TLML
American kestrel	TMC
Big brown bat	TMC
California myotis	TMC
European starling	TMC
Little brown myotis	TMC
Silver-haired bat	TMC
Bohemian waxwing	TMGG
Common nighthawk	TMGG
Cooper’s hawk	TMGG
Gray flycatcher	TMGG
Gray jay	TMGG
Hoary bat	TMGG
Long eared owl	TMGG
Long-eared myotis	TMGG
Long-legged myotis	TMGG
Long-tailed weasel	TMGG
Mule deer and black-tailed deer	TMGG
Northern flicker	TMGG
Northern saw-whet owl	TMGG
Porcupine	TMGG
Sharp-shinned hawk	TMGG
Spotted skunk	TMGG
Striped skunk	TMGG
Virginia opossum	TMGG
Western rattlesnake	TMGG
Western small-footed myotis	TMGG
Wild turkey	TMGG
Yuma myotis	TMGG
Badger	TMME
Merlin	TMME
Black-backed woodpecker	TMML
Northern three-toed woodpecker	TMML
Cassin’s finch	TSC
Flammulated owl	TSC
Lewis’ woodpecker	TSC
Olive-sided flycatcher	TSC
Ash-throated flycatcher	TSGEM
Bewick’s wren	TSGEM
Fox sparrow	TSGEM
House wren	TSGEM
Willow flycatcher	TSGEM
American robin	TSGG
Band-tailed pigeon	TSGG

Black-capped chickadee	TSGG
Black-chinned hummingbird	TSGG
Black-headed grosbeak	TSGG
Black-throated gray warbler	TSGG
Blue grouse	TSGG
Brown-headed cowbird	TSGG
Brush rabbit	TSGG
Cascade frog	TSGG
Cedar waxwing	TSGG
Chestnut-backed chickadee	TSGG
Chipping sparrow	TSGG
Clark’s nutcracker	TSGG
Clouded salamander	TSGG
Coast mole	TSGG
Common garter snake	TSGG
Dark-eyed junco	TSGG
Deer mouse	TSGG
Douglas’ squirrel	TSGG
Dusky shrew	TSGG
Ensatina	TSGG
Ermine	TSGG
Evening grosbeak	TSGG
Golden-crowned kinglet	TSGG
Golden-mantled ground squirrel	TSGG
Hairy woodpecker	TSGG
Hammond’s flycatcher	TSGG
Hermit thrush	TSGG
House finch	TSGG
House sparrow	TSGG
Hutton’s vireo	TSGG
Long-toed salamander	TSGG
Mountain beaver	TSGG
Mountain chickadee	TSGG
Mourning dove	TSGG
Nashville warbler	TSGG
Northern alligator lizard	TSGG
Northern oriole	TSGG
Northern pygmy owl	TSGG
Northwester salamander	TSGG
Norway rat	TSGG
Oregon meadow vole	TSGG
Pacific jumping mouse	TSGG
Pacific treefrog	TSGG
Pine grosbeak	TSGG
Pine siskin	TSGG
Purple finch	TSGG
Raccoon	TSGG

Racer	TSGG
Red crossbill	TSGG
Red-breasted sapsucker	TSGG
Red-legged frog	TSGG
Red-naped sapsucker	TSGG
Ringneck snake	TSGG
Roughskin newt	TSGG
Rubber boa	TSGG
Ruby-crowned kinglet	TSGG
Ruffed grouse	TSGG
Rufous hummingbird	TSGG
Rufous-sided towhee	TSGG
Sharptail snake	TSGG
Snowshoe hare	TSGG
Solitary vireo	TSGG
Song sparrow	TSGG
Southern alligator lizard	TSGG
Steller’s jay	TSGG
Swainson’s thrush	TSGG
Townsend’s chipmunk	TSGG
Townsend’s solitaire	TSGG
Tree swallow	TSGG
Vagrant shrew	TSGG
Vaux’s swift	TSGG
Violet-green swallow	TSGG
Warbling vireo	TSGG
Wester red-backed salamander	TSGG
Western gray squirrel	TSGG
Western screech owl	TSGG
Western skink	TSGG
Western tanager	TSGG
Western toad	TSGG
Western wood-peewee	TSGG
Wilson’s warbler	TSGG
Winter wren	TSGG
Yellow warbler	TSGG
Yellow-pine chipmunk	TSGG
Yellow-rumped warbler	TSGG
Downy woodpecker	TSGML
Hermit warbler	TSGML
Northern flying squirrel	TSGML
Oregon slender salamander	TSGML
Red-breasted nuthatch	TSGML
Townsend’s warbler	TSGML
Varied thrush	TSGML
Western red-backed vole	TSGML
White-breasted nuthatch	TSGML

White-winged crossbill	TSGML
Williamson’s sapsucker	TSGML
American goldfinch	TSME
Black-tailed rabbit	TSME
Brewer’s blackbird	TSME
Brewer’s sparrow	TSME
Bushtit	TSME
California quail	TSME
Calliope hummingbird	TSME
Green-tailed towee	TSME
Lesser goldfinch	TSME
Mountain quail	TSME
Northern shrike	TSME
Scrub jay	TSME
Tennessee warbler	TSME
Western fence lizard	TSME
Western kingbird	TSME
California ground squirrel	TSPE
Dusky flycatcher	TSPE
Golden-crowned sparrow	TSPE
Gopher snake	TSPE
Heather vole	TSPE
Horned lark	TSPE
Lark sparrow	TSPE
Lazuli bunting	TSPE
Lincoln’s sparrow	TSPE
MacGillivray’s warbler	TSPE
Mountain bluebird	TSPE
Night snake	TSPE
Northwester garter snake	TSPE
Orange-crowned warbler	TSPE
Ring-necked pheasant	TSPE
Savannah sparrow	TSPE
Townsend’s vole	TSPE
Vesper sparrow	TSPE
Water pipit	TSPE
Western bluebird	TSPE
Western meadowlark	TSPE
Western pocket gopher	TSPE
Western terrestrial garter snake	TSPE
White-crowned sparrow	TSPE
White-throated sparrow	TSPE
Wrentit	TSPE
Brown creeper	TSPL
Cordilleran flycatcher	TSPL
Pacific slope flycatcher	TSPL
Red tree vole	TSPL

Shrew-mole	TSPL
Trowbridge’s shrew	TSPL

Appendix D

McKenzie Watershed Council Program Objectives

Overall Objective

Maintain and enhance the quality of the McKenzie Watershed
for water quality, recreation, fish & wildlife habitat and human habitat.

Program Objectives

Program Objective 1.	***Maintain & enhance water quality for drinking water, water-contact recreation, habitat for salmon & trout, macroinvertebrates, & other life forms, economic stability, and aesthetics.***
Program Objective 2.	***Maintain, restore & enhance biodiversity & healthy ecosystems: habitat (e.g., riparian, wetland, forest, riverine); species (e.g., plants, animals, including threatened and endangered and sensitive species)***
Program Objective 3.	***Encourage sustainable resource management practices (forestry, agriculture, fishing)***
Program Objective 4.	***Encourage employment opportunities related to watershed maintenance & enhancement***
Program Objective 5.	***Provide a wide variety of recreational opportunities for residents & visitors (dispersed recreation vs. concentrated, water/instream vs. upland) for the following activities: hiking, backpacking, boating, fishing, viewing (scenic, painting, photo), bicycling, motoring, picnicking, camping, access***
Program Objective 6.	***Maintain "wild" river characteristics for high quality recreation experience (access, motorized boats)***
Program Objective 7.	***Maintain "rural" character outside Urban Growth Boundary in the following areas: residential, businesses, number of jobs, transportation, open space, parks, natural wilderness areas, facilities and services, and unincorporated rural communities***
Program Objective 8.	***Encourage economic activities complementary to the "rural" character of the watershed***

Process Objectives

In the overall approach to analyzing each topic, the council has agreed on the following objectives:

Process Objective 1. ***Coordinate the McKenzie Watershed Program within the regional context. Link program with adjacent watersheds (e.g., Umpqua, Santiam & Middle Fork), regional efforts, issues and initiatives (e.g., Willamette Valley Initiative and NW forest issues, DEQ Willamette Basin Study, FEMAT, Province Team)***

Process Objective 2. ***Encourage coordinated resource management using a whole system approach***

Process Objective 3. ***Improve coordination of recreation management among public/private providers including the following areas: monitoring needs and use, facility planning and construction (land, improvements), and maintenance (litter, vandalism)***

Process Objective 4. ***Promote education that encourages good stewardship among user groups including: property owners, residents, visitors, and resource managers***

Appendix E

Actions Previously Undertaken or Proposed

Key:
· = proposed action
Ö = action taken or in progress

Other Actions Already Taken by Council

Ö Project application for GWEB grant to develop and implement a pilot citizen monitoring program
Ö Calendar competition for school children in the basin
Ö Urged federal, state, and local agencies with jurisdiction to continue to cooperate and pursue full and complete restoration of private property on McNutt Island and the north band of the McKenzie River
Ö Letter to Senator Hatfield and Representative DeFazio supporting the need to temperature control devices at the Cougar and Blue River dams and opposing the 25 percent local cost share requirement proposed by the Corps
Ö Indicated support for the Willamette National Forest Integrated weed Management Program
Ö Review draft USFS South Fork McKenzie Watershed Analysis
Ö Review BLM's Draft McKenzie River Recreation Area Management Plan
Ö Letter supporting ACOE's efforts to achieve pre-reservoir temperature regimes in the McKenzie basin through the use of multilevel ported intake structures at Cougar and Blue River Reservoirs. letter included specific comments on the Draft EIS for these projects
Ö Letter to SWMG supporting the results of the watershed assessment
Ö Endorse McKenzie Watershed Teacher Training Project, a free summer workshop sponsored by EWEB

Actions Suggested by Council as Potential Early Action Opportunities

· Watchable Botany Site - in the Coburg hills adjacent to a well traveled road, this site has over 200 species of plants. Site needs trail construction and interpretive signs.
· Erosion control project at Hendricks Wayside (State Parks and Recreation)
· Sponsor replanting of a clear-cut
· Demonstration project for off-stream livestock watering (GWEB $)
· Enhancement of existing pond on private land. Benefits for native fish and pond turtles. ODFW supports project and may have funds.
· Watershed council support the Leaburg Fish Hatchery Project. Future opportunity for the council to be involved in public education and display at the hatchery.
· Adopt-a-River Program would focus on monitoring water quality and keeping areas clean. Focus on Mohawk River first
Ö Participate in local community events (Lane County Fair)
Ö Watershed council newsletter
· River Etiquette brochure
· ODOT corridor study (begins January 95 at the earliest)
· Watershed council endorse list of restoration projects to Province team (FY 95)

- Ö The McKenzie Watershed Council itself
- · Leaburg fish hatchery (support funding through Northwest Economic Initiative)
- · McKenzie Communities Implementation Plan (Economic Development plan and vision for the area. Support funding by Forest Service)
- Ö BLM Recreation Management Plan (opportunity for comment)
- Ö Willamalane PROS plan (opportunity for comment)
- · Periodic review (DLCD) of rural and metropolitan comprehensive plans, chance to change riparian and stream setbacks
- · Salmon Watch program
- · SUB's Wellhead Protection Study (opportunity for comment)
- Ö Three Basin Rule Advisory Committee (opportunity for comment)
- · Support Lane County OSU Extension ground-water testing
- Ö Volunteer Coordinator

<u>Actions Suggested by Citizen Involvement Subcommittee</u>

- Ö Volunteer coordination for restoration and monitoring projects on private and federal lands
- · Site and landowner identified by BLM for riparian restoration and dam/culvert projects
- Ö Monitor wildlife on BLM land
- Ö Demonstration projects will willing property owners on private lands
- · Meadow restoration on BLM land to create a watchable botanical site
- Ö Work with industrial timber companies to do restoration project with volunteers
- · In coordination with Water Quality Task Group, recruit citizens and students for water quality monitoring projects
- Ö Request that Lane County-OSU expand nitrate testing into McKenzie
- Ö Coordinate, promote, recruit folks for presentation to Residents groups about Riparian vegetation rules

<u>Actions Suggested by the Water Quality Task Group</u>

- Ö Assist landowners in project implementation and provide on-going technical support
- Ö Assist SWCD in identifying and recruiting private landowners in the McKenzie basin to participate in demonstration projects
- · Coordinate with water quality data collection entities to continue sampling at sites with long-term information legacies
- Ö Develop and implement a monitoring program to track water quality in the basin
- · Recruit citizens, school groups, organizations, private industry, and agencies to participate in water quality monitoring program
- · Coordinate with OSU Extension-Lane County Groundwater Committee to expand the volunteer well sampling program to include the pilot monitoring area
- Ö Inventory water quality data for the McKenzie basin
- · Analyze historical data on water chemistry, stream flow, and aquatic communities (specifically macroinvertebrates and algae), to the extent possible, to determine baseline conditions, trends, data gaps, and problem areas for the McKenzie River and its tributaries
- · Develop resource management plans for demonstration projects in collaboration with participating landowners
- · Coordinate with recruited data collection entities to agree on a common monitoring protocol,

monitoring network, quality assurance program, and data storage and analysis system for ongoing water quality monitoring
- Ö Examine existing citizen/student water quality monitoring programs which could be employed in a water quality monitoring network
- Add water quality monitoring data to the McKenzie GIS database to facilitate tracking and analysis
- Assemble a team to develop indicators which will be effective in monitoring potential threats to water quality
- Track water quality indicators utilizing the McKenzie GIS database to facilitate temporal and spatial analyses

<u>Actions Suggested by the Fish and Wildlife Habitat Task Group</u>

- Develop and implement a monitoring program to track habitat health
- Decommission unnecessary roads
- Identify and correct faulty road culverts
- Encourage land use practices that minimize stream sedimentation
- Encourage vegetation management practices that increase growth of vegetation especially large conifers in riparian corridors
- Encourage improved stream temperature regimes by proper manipulation of flow releases from dams
- Encourage establishment of legal flows on more streams important for native fish and wildlife
- Adopt a road closure program during critical periods
- Encourage floodplain restoration programs
- Monitor down-cutting caused by dams
- Analyze secondary channels on the main-stem to determine if they are becoming more isolated
- Monitor rip-rapping projects particularly along the main-stem
- Establish and assess the current baseline conditions for various parameters affecting fish and wildlife habitat
- Encourage riparian corridor and floodplain education programs
- Monitor projects on public and private lands for plan compliance
- Facilitate a yearly conference among land manager within the watershed to review management plans for fish and wildlife
- Annually assess the status of special habitats and review net losses and determine reasons for loss
- Review management and silviculture practices in riparian areas
- Identify and preserve key habitat areas:
    - Consider future recruitment of woody debris
    - Focus restoration efforts in the lower main-stem and Mohawk sub-basin
    - Urban and agricultural lands are key to consider for restoration

<u>Actions Suggested in Environmental Risk Assessment of EWEB's Drinking Water Supply</u>

Agricultural Activities:
- Examine the results of ongoing water quality studies to determine whether agricultural impact on surface water quality in the McKenzie River are increasing or decreasing in response to evolving management standards

- Continue to take an active interest in ensuring that proper management measures are adequately enforced in the watershed
- Work in conjunction with the appropriate agencies to establish educational or technical assistance programs for farmers and rural homeowners in the watershed study area

Dams, Powerhouse, and Fish Hatcheries:
- Evaluate whether certain modification to equipment or operations at dams, powerhouses, and fish hatcheries could reduce the potential for adverse water quality impact associated with their operations

Forestry Activities:
- Examine the results of several ongoing studies to determine whether forest practice impacts on surface water quality in the basin are increasing or decreasing in light of evolving management standards
- Continue to take an active interest in ensuring that proper forest management measures are adequately enforced in the watershed study area
- Work with other agencies to conduct a comprehensive watershed analysis for the McKenzie River

Hazardous Material Transport:
- Determine a reliable estimate for time-of-travel from various points on the McKenzie River to the Hayden Bridge intake
- Strengthen the response and communication network involving EWEB, SUB, and the Rainbow Water District, and include a variety of public safety and public works agencies
- Coordinate with EWEB, SUB, and the Rainbow Water District to establish agreed upon response procedures in the event a spill threatens the drink water supply
- Position trained personnel and/or equipment at selected locations along the river for emergency response to certain types of incidents
- Periodically test the response plan

Recreation:
- In conjunction with DEQ, boating and fishing groups, etc., develop data from the McKenzie River and elsewhere in Oregon that would illustrate impacts to water quality from recreational use
- Encourage boaters and anglers to practice more care with regard to streambank erosion and waste disposal
- Use volunteer monitors to help identify and prevent abuses