McKenzie Watershed

The McKenzie River, located in Oregon, runs west from the Cascade Mountains into the Willamette Valley. There, it empties into the Willamette River just outside of the Eugene/Springfield metropolitan area. The watershed that defines the McKenzie River encompasses approximately 1,300 square miles, nearly 300 square miles larger than the state of Rhode Island [see figure 1] (McKenzie Watershed Council, 2003).

The geography of the McKenzie watershed is very diverse. Elevation ranges from 10,358 feet above sea level at the summit of South Sister in the High Cascades down to 430 feet in the Willamette Valley. From mountainous terrain to gentle sloping valleys, elevation change in the watershed correlates with dramatic change in vegetation and topography (Lane Council of Governments, 1996: 4).

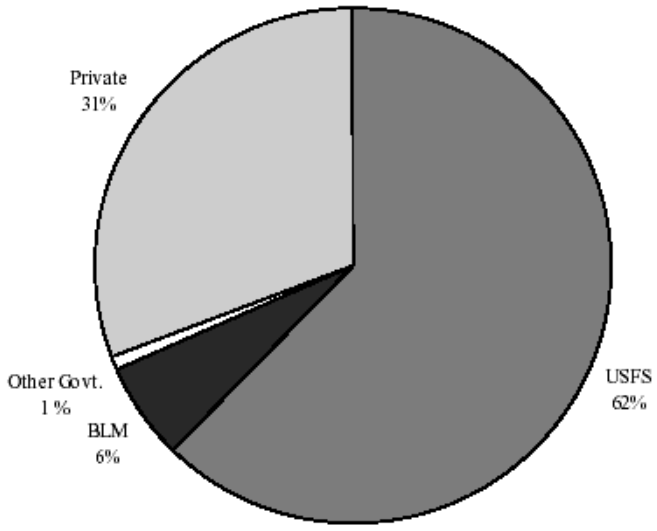
A majority of the watershed is publicly owned, with the United States Forest Service managing nearly 500,000 acres of land [see figure 2]. Nearly half of that land is federally designated as wilderness. Unfortunately, less than one percent (359 acres) of the watershed is old growth forest (Oregon Department of Fish and Wildlife, 1990: 16,18).

Figure 1: Location of the McKenzie Watershed

Source: McKenzie Watershed Council. www.mckenziewatershedcouncil.org/mckenzieatlas/basin_map.htm. 9 Mar 2003.

The McKenzie Watershed (HUC #17090004) represents a relatively large drainage basin with a diverse array of physical characteristics. Similarly, the watershed incorporates many social and cultural attributes. Addressing these issues will provide a look at such features as hydrology, dams, threatened and endangered species, and hatchery operations.

Figure 2: Land ownership in the McKenzie Watershed



Source: Lane Council of Governments. 1996. Technical Report for Water Quality and Fish and Wildlife Habitat. Lane Council of Governments, Eugene, OR. Prepared for the McKenzie Watershed Council, p.21.

Demographics

The McKenzie Watershed is relatively unpopulated given its size and location to the Eugene/Springfield metropolitan area. Population figures from 1990 estimate 22,648 people living in the watershed (Lane Council of Governments, 1996: 23). Despite this small population, the McKenzie watershed is subject to various stresses. However, these stresses originate mainly from outside sources. Water from the McKenzie watershed supplies roughly 200,000 people (mostly in Eugene and Springfield) with drinking water. In addition, major industries like Weyerhaeuser Company and Agripak Inc. draw 20 million and 435,600 gallons a day respectively from the McKenzie River (Lane Council of Governments, 1996: 16). The watershed is also a popular recreation area for those living in and outside of it. Activities like kayaking, rafting, and drift boat fishing are widely enjoyed (Lane Council of Governments 1996: 33).

If isolated, the McKenzie Watershed could be relatively pristine and unaltered due to its small population. However, its water resources are used to support industry and

populations that have their foundations outside of the watershed. Consequently, the watershed is bearing impacts disproportional to interests and activities generated from within.

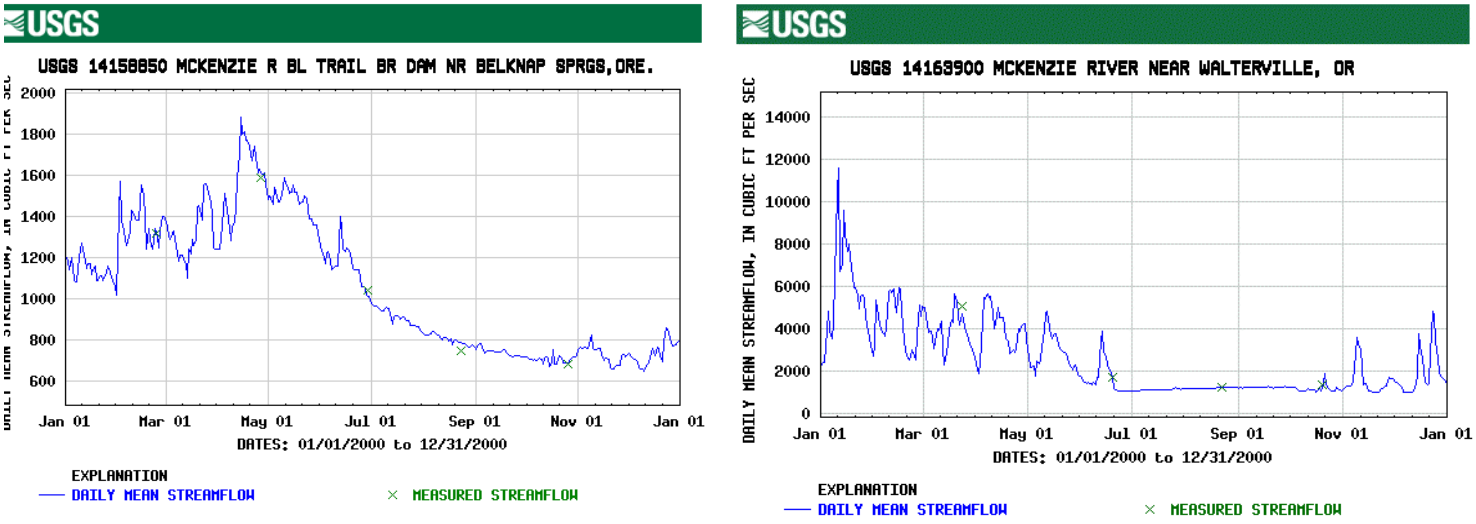
Hydrology

The McKenzie watershed is replete with streams, containing 1,780 stream miles, 1,040 of them perennial (Lane Council of Governments, 1996: 5). Unfortunately, many of these stream miles have been altered. The Technical Report for Water Quality and Fish and Wildlife Habitat states, "Natural flow patterns have been altered by dams, diversions, water withdrawals, roads, and changes in the landscape vegetation" (Lane Council of Governments, 1996: 17). The report also contends that peak flows and stream competence (the ability of the stream to move bedload) have decreased over time. Specifically, it reports mean peak flows down forty-four percent and competence down 29 percent (Lane Council of Governments, 1996: 38). The is due to the presence of dams, which tend to moderate streamflow in the watershed by raising summer water levels and decreasing winter water levels (Hurley, pers. comm., 2003). Dams also reduce the occurrence of flooding, thus reducing peak flows [dams will be discussed in more detail later in the report].

Despite moderation by dams, streamflow patterns are highly variable over the year because of climatic variance. Precipitation in the McKenzie watershed ranges from forty-five inches in the Willamette Valley to 130 inches (falling mostly as snow) in the Cascades (McKenzie Watershed Council, 2003). Streamflow in the area closely mirror seasonal patterns of rainfall and snowmelt, with snowmelt contributing more to streamflow in higher elevations. (Lane Council of Governments 38). The majority of precipitation occurs

during the winter months with snowmelts occurring in the spring (Lane Council of Governments, 1996: 6). *Figure 3* shows daily streamflow in the McKenzie River over 2000. The graphs display the seasonal variance in streamflow that results from heavy precipitation during the winter months. The graphs also demonstrates the difference in discharge close to the headwaters (left) and waters near the mouth (right). Notice that the headwater's streamflow peaks in April when snowmelt is high, meanwhile, waters near the mouth peak in January, reflecting winter rainfall patterns.

igure 3: Annual hydrographs of two separate points on the McKenzie River



ource: United States Geologic Service. "Surface-Water Data for the Nation." http://waterdata.usgs.gov/nwis/sw. 9 Mar 2003.

Fish

The McKenzie watershed is quite diverse with its numerous streams and hundreds of lakes. These physical settings provide great support for many different types of fish. Twenty-two native and seven to twelve non-native fish species call the McKenzie watershed home. Some examples of fish in the watershed are spring chinook salmon,

steelhead trout, lamprey, sculpin, bull trout, and white sturgeon (Lane Council of Governments 1996: 64, 18).

The health of fish and their habitat is a key issue in the McKenzie watershed. The Oregon Department of Fish and Wildlife have identified several goals in the McKenzie watershed for improving wild fish populations and habitat.

- "Increase natural production of spring chinook"
- "Maintain high numbers of wild trout"
- "Increase survival of spring chinook and summer steelhead"
- "Reduce the impacts of timber harvest on fish production"
- "Reduce the Impacts of Leaburg and Walterville canals on migration, spawning, rearing, and angling"

(Lane Council of Governments 1996: 64)

As is noticeable from the bulleted list, particular attention is given to chinook salmon and steelhead trout. Although these fish are popular as a food resource and for recreational fishing, they receive special care because of their federal designation under the Endangered Species Act (ESA). Specifically, two andaromous species, chinook salmon and steelhead trout, are both listed as threatened under the ESA. Non-anadromous fish in the McKenzie watershed listed under the ESA are bull trout (threatened) and Oregon chud (endangered) (US Fish and Wildlife Service 2003).

Numbers of spring chinook salmon (*Oncorhynchus tshawytscha*) in the McKenzie watershed have decreased over time for a number of reasons. In the Mohawk River, a tributary of the McKenzie, chinook salmon were extirpated around 1910. Current conditions in the Mohawk River, as well as Camp Creek, make the water uninhabitable for

adult salmon due to warmer than normal water during the summer, a lack of holding pools, and flows that are too low during the spawning season (Lane Council of Governments, 1996: 64) [see figure 5 for chinook spawning areas]. Throughout the rest of the watershed, population decline is due to the construction of several dams and the simplification of stream channels. Dams have blocked migratory routes, increased or decreased seasonal water temperatures, and blocked sediment and gravel that are crucial for habitat. Stream simplification, meaning anything from removal of large woody debris to stream channelization, has occurred from the late 1800's and correlates with decreases in stream productivity (Lane Council of Governments, 1996: 64).

Bull trout (*Salvelinus confluentus*) in the McKenzie River are considered the "only significant population remaining west of the Oregon Cascades" (Lane Council of Governments 1996: 66) and suffer from similar impacts as do chinook salmon. Like many threatened and endangered species, the bull trout has rather narrow habitat requirements. It requires very cold temperatures and complex stream cover including pools, woody debris, and undercut banks. Changes in the stream's ecology, as well as over harvest and interbreeding with brook trout, have led to its decline (Lane Council of Governments 1996, 66).

Bull trout and and chinook salmon are two examples of human impacts on natural resources that were once self-perpetuating and plentiful. As these two species face the possibility of extinction, people and institutions are working to stop their decline and reverse the ill effects of development in the region. Water diversions for irrigation, municipal use, and industry coupled with the effects of dams and stream simplification has hindered fish to the point that some may not be able to survive on there own.

Hatcheries

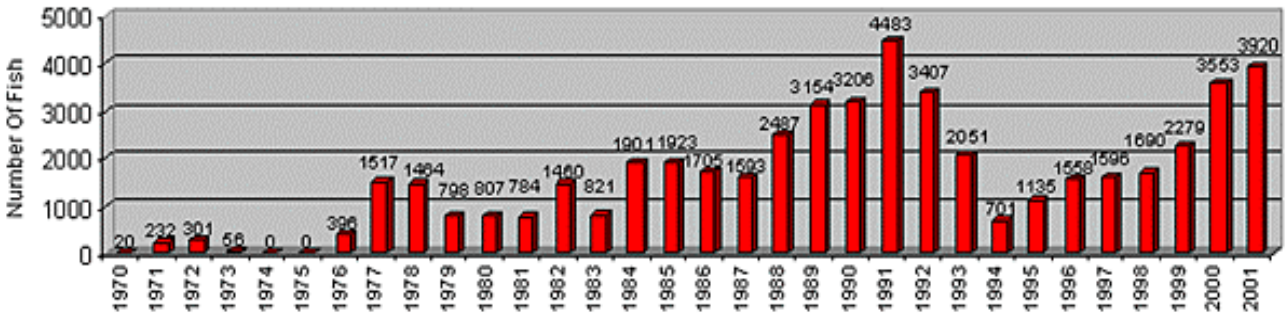
Hatcheries are being used in the McKenzie watershed to mitigate the loss of salmon and trout. The United States Army Corps of Engineers (USACE) heavily funds this process as mitigation for habitat degradation resulting from dam building. Thanks to the USACE, the McKenzie is one of the most stocked rivers in Oregon (Lane Council of Governments 1996: 17).

The McKenzie watershed has two hatcheries, the McKenzie Hatchery and the Leaburg Hatchery [see figure 5]. The McKenzie Hatchery was built in 1938 and has been in operation ever since. The USACE rebuilt the facility in 1975 as part of their mitigation responsibilities (Oregon Department of Fish and Wildlife(a), 2003).

The mission of the McKenzie Hatchery is to rear and releases approximately 1.2 million spring chinook salmon a year. The hatchery accomplishes this by collecting returning salmon between May and September. These returning salmon enter the hatchery voluntarily by means of a fish ladder. Once inside the hatchery, the adult salmon are held in what the hatchery calls the "adult collection facility" (Oregon Department of Fish and Wildlife(a), 2003). Salmon that return early (May as opposed to September) are injected with antibiotics to defend against disease. Once females are biologically ready, they are incised ventrally and their eggs removed. Sperm collected from the male chinook, called "milt" (Oregon Department of Fish and Wildlife(a), 2003), is manually mixed with the eggs, thus fertilizing them. Fertilized eggs are then placed in incubators until the fry develop. Once developed, juvenile salmon are placed in rearing troughs in numbers up to 300,000. Naturally, as the juvenile salmon develop and grow they are separated into different holding ponds. Juvenile salmon mature for eleven to fifteen months, or until six

to seven inches long. The artificial reproduction process takes only 440-500 females and equal part males to rear 1.2 million salmon. This success is due to the high rate of egg survival produced by the controlled and protected environment of the hatchery (Oregon Department of Fish and Wildlife(a), 2003).

Figure 4: McKenzie Hatchery spring chinook returns



Source: Oregon Department of Fish and Wildlife. "McKenzie Hatchery." http://www.oregonvos.net/~mckenzie/index.htm#HOME. 9 Mar 2003.

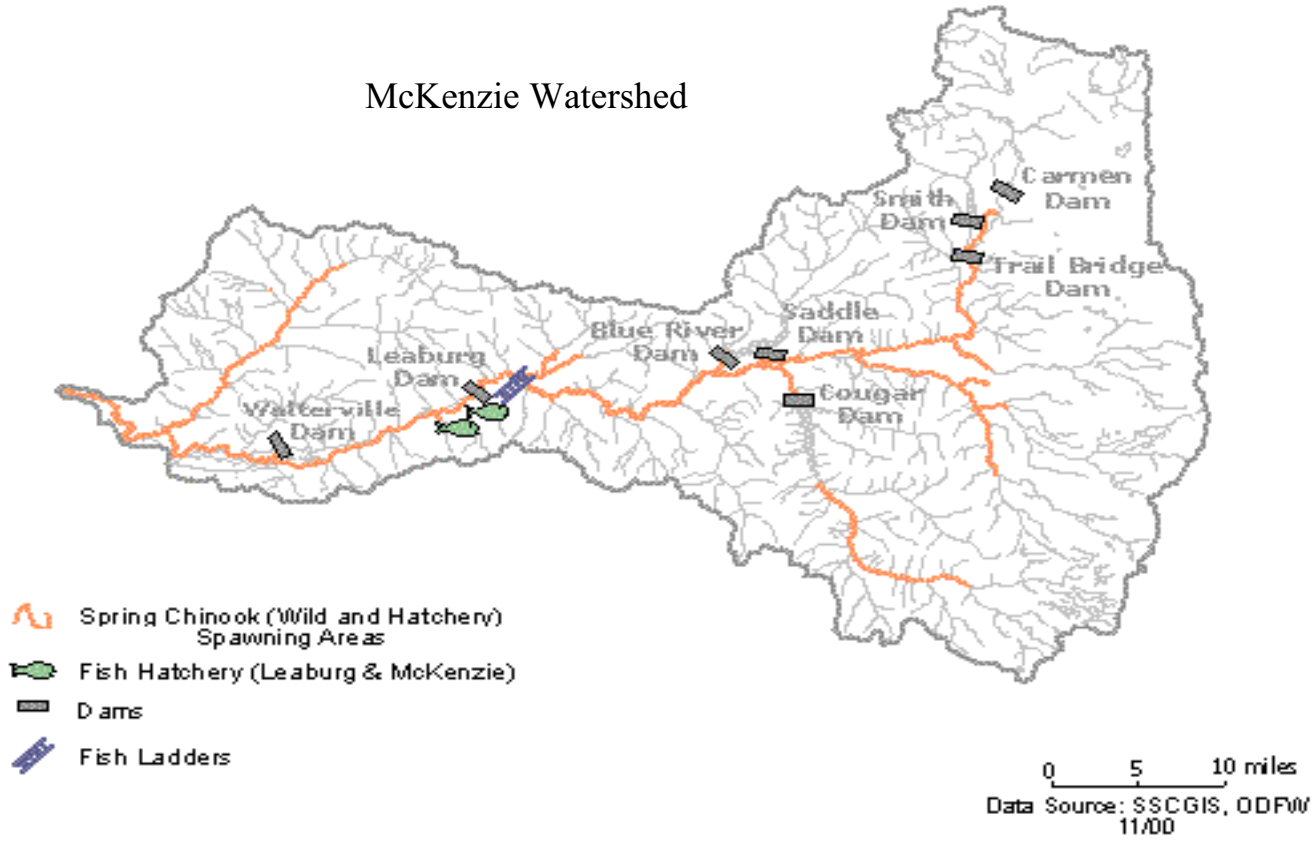
The watershed's other hatchery, Leaburg Hatchery, is touted as the "largest trout hatchery on the West Coast" (Oregon Department of Fish and Wildlife(b), 2003), impressive considering that it only has seven employees. The hatchery earned this distinction because it produces nearly 1million trout annually. Leaburg Hatchery rears and releases rainbow, cutthroat, and steelhead trout. The USACE also funds some of the hatchery's production, including the creation of the hatchery in 1953 (Oregon Department of Fish and Wildlife(b), 2003).

The hatcheries in the McKenzie watershed provide the region with an opportunity to reestablish historic levels of trout and salmon. The necessity of these hatcheries is, however, testament to the impact humans have had on the watershed. Human influence in the area has effectively reduced certain species to the point that they are threatened or in

danger of extinction. There is no substitution for the real thing, but when conservation strategies are limited and the risk of losing a species is high, hatchery fish can be a close second to wild fish.

Reestablishment of threatened trout and salmon species is important ecologically, ethically, and economically. It is important ecologically because these species have co-evolved with the natural environment; they are dependent on each other. It is important ethically because, as stewards of the environment, we are responsible for their welfare. Lastly, it is important economically because these species support commercial and recreation fishing. Overall, hatchery production in the McKenzie watershed can be seen as a beneficial activity with tangible results.

Figure 5: Dams, hatcheries, and chinook spawning area in the McKenzie Watershed



Source: McKenzie Watershed Council. www.mckenziewatershedcouncil.org/mckenzieatlas/chinook_map.htm. 9 Mar 2003.

Dams

There are eight dams in the McKenzie watershed [see figure 5], six owned and operated by the USACE (US Bureau of Reclamation, 2001: 43) and two owned and operated by the Eugene Water and Electric Board (EWEB). EWEB runs the Walterville and Leaburg Dams while the USACE operates the Blue River, Cougar, Saddle, Trail Bridge, Smith, and Carmen Dams. As may be expected, EWEB operates the dam for hydroelectric purposes. (Lane Council of Governments, 1996: 16). The USACE operates its dams for flood control, irrigation, and hydropower (US Bureau of Reclamation, 2001: 43). The development of dams in the McKenzie watershed is partly a result of its steep gradients, which is good for creating hydroelectricity (Lane Council of Governments, 1996: 16)

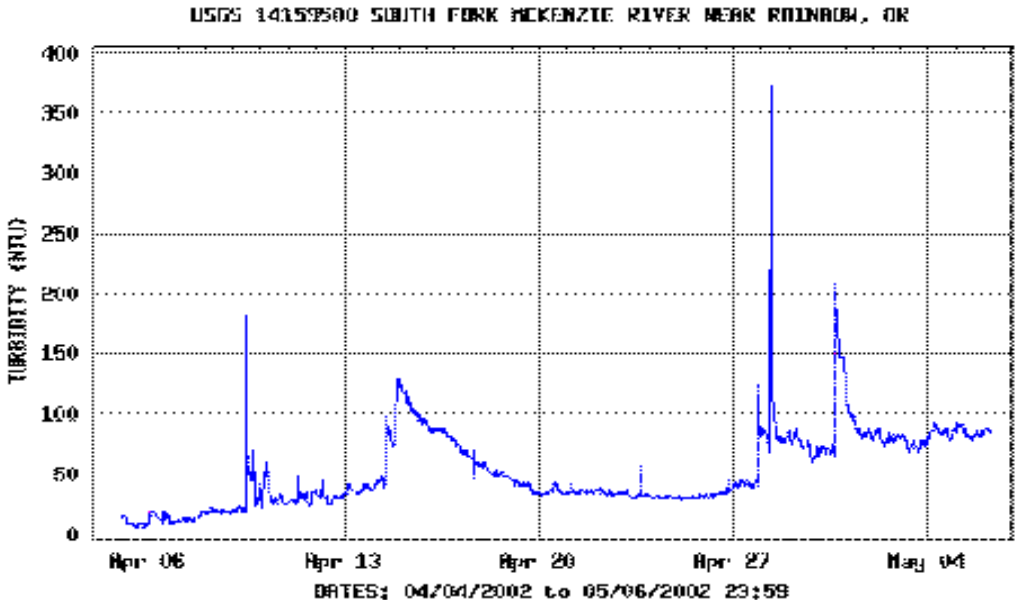
As mentioned before, dams in the McKenzie watershed have created limitations on fish survival. One major concern is the obstruction of migratory fish routes. This obstruction leads to reduced spawning and population declines (Lane Council of Governments, 1996: 64).

Another salient issue facing fish survival is the alteration of water temperatures. After the construction of Cougar and Blue River Dams, seasonal temperatures have increased from three to six degrees Celsius in the fall and decreased eight to twelve degrees Celsius during spring and early summer (Lane Council of Governments, 1996: 65). Cold water released during spring is harmful to migrating salmon, which stay away from these areas of colder water. Warmer waters released during the fall cause salmon eggs to hatch earlier, when food is less available (US Army Corps f Engineers, 2003).

As a way to mitigate damages to fish from temperature changes, the USACE will be retrofitting Cougar and Blue River Dams with adjustable weir gates. The adjustments made at the dams will correct the temperature problem by drawing water from various levels in the reservoir. Currently, the dams draw water from the bottom of the reservoir, which leads to temperature discrepancies with the streams below. Construction on Cougar Dam already began in 1999 and is scheduled to be completed in 2004. The retrofit is costing the USACE $41 million (US Army Corps of Engineers, 2003).

During construction at Cougar Dam, engineers encountered an unexpected rise in turbidity below the dam [see figure 6]. During construction phase, engineers lowered the reservoir to 1/3 its normal height. This act exposed forty years of sediment that had accumulated behind the dam. The lowered water in the reservoir disturbed the sediment and transported it downstream. This generated many complaints from fishermen, rafters, and others who use the McKenzie River recreationally (Oregon Department of Fish and Wildlife(c), 2003). The rise in turbidity may have also had unseen impacts on fish and other wildlife.

Figure 6: Increases in turbidity as a result of construction at Cougar Dam



Source: Oregon Department of Fish and Wildlife.
http://www.dfw.state.or.us/ODFWhtml/springfield/mck_turbidity.pdf. 11 Mar 2003.

The presence of dams in the McKenzie watershed clearly illustrates the needs of human development. Hydroelectricity and flood protection are used to support not only those living in the watershed, but people living throughout the Willamette subbasin. However, the construction projects at Cougar and Blue River Dams demonstrate a growing awareness of ecological processes and our sense of responsibility. Regardless of this, the watershed is neglecting other aspects of ecological issues like fish ladders (only one exists in the watershed despite having eight dams) (Lane Council Of Governments, 1996: 64). Also, tests of fish tissue report that toxics are occasionally found in excess of the Environmental Protection Agency's standards. These toxics include arsenic, PCBs, alderin, and DDT (Lane Council of Governments 1996: 36). The presence of toxics in fish could be a function of dam construction; toxics can sometimes build up in sediments behind dams (Hurley, pers. comm., 2003). As is evident, certain activities in the McKenzie watershed are mitigating the ill effects of dams. However, at the same time not enough is being done. Dams in the McKenzie watershed can still be viewed as a threat to stream ecology.

Conclusion

The McKenzie watershed is large and geographically diverse. Some of the important issues affecting the region relate to hatchery production, threatened and endangered fish, and dams. Likewise, basic hydrology and demographics are important to understanding the watershed.

Much is being done in the area to mitigate losses to its natural resources. Meanwhile, much is being done to further those losses. These loses may also stem from what is *not* being done. The McKenzie watershed represents an area that, if restored and protected, could continue to fit the needs of humans and fish into the future.

Works Cited

Hurley, Patrick. 2003. Personal Communication.

Lane Council of Governments. 1996. Technical Report for Water Quality and Fish and Wildlife Habitat. Lane Council of Governments, Eugene, OR. Prepared for the McKenzie Watershed Council.

McKenzie Watershed Council. 2003. "About the McKenzie Watershed" http://www.mckenziewatershedcouncil.org/about.html. 12 Mar 2003.

Oregon Department of Fish and Wildlife. 1990. Salmon and Steelhead Production Plan, McKenzie River, Willamette River Subbasin. Northwest Power Planning Council, Portland, OR.

Oregon Department of Fish and Wildlife(a). 2003. "McKenzie Hatchery." www.oregonvos.net/~mckenzie/index.htm#HOME. 9 Mar 2003.

Oregon Department of Fish and Wildlife(b). 2003. "Leaburg Trout Hatchery." www.dfw.state.or.us/ODFWhtml/Springfield/Leaburg_Hatchery.html. 9 Mar 2003.

Oregon Department of Fish and Wildlife(c). 2003. "Minimizing Risks and Mitigation of Impacts to Bull Trout *Salvelinus confluentus* from Construction of Temperature Control Facilities at Cougar Reservoir, Oregon." http://www.dfw.state.or.us/ODFWhtml/springfield/cougar_project.html. 10 Mar 2003.

United States Army Corps of Engineers. 2003. "Willamette River Temperature Control Project." www.nwp.usace.army.mil/issues/wrtcp. 9 Mar 2003.

United Sates Bureau of Reclamation. 2001. Evaluation of Six Priority Subbasins for the Implementation of 1-Year Plans in Fiscal Year 2002. United States Bureau of Reclamation website. 13 Nov 2003. <http://www.pn.usbr.gov/project/salmon/subbasin/pdf/subbasin-evals-full.pdf>.

United States Fish and Wildlife Service. 2003. "Federally Listed, Proposed and Candidate Which May Occur Within Oregon." http://oregonfwo.fws.gov/EndSpp/Documents/ORLIST.pdf. 10 Mar 2003.