A CHANGING LANDSCAPE

INTRODUCTION

In 1800, much of the Sandy River Basin remained untouched by human development. The ecosystem, as discussed in the last chapter, provided a healthy environment for salmon and steelhead production. A diverse growth of trees and understory vegetation still armored most stretches of the Sandy River and its tributaries. The river ran cool and steady through the year supporting strong populations of salmon, steelhead and resident fish. This ecosystem was not absolutely stable. As in all river systems, natural events caused regular and sporadic changes in the ecosystem over time. For example, seasonal floods often caused the stream channel to move or create meanders. Still, the channel maintained a long term balance as its overall health allowed it to recover from naturally occurring disturbances.

Human activities, especially those after the early 1800s, changed this ecosystem. As more people moved into the area, the natural landscape and river system were developed and harnessed to provide for their growing needs. They harvested riparian forests, removed instream logs and other wood, extracted sand and gravel from the stream channel, built dams, and diverted streamflows, thus altering habitat conditions that supported Sandy River salmon and steelhead populations. By changing conditions in the watershed, they contributed to a dramatic decline in salmon and steelhead production.

This section reviews settlement and development in the basin over time. It provides a context for understanding how a combination of actions through the years contributed to the degradation of wild salmon and steelhead runs in the Sandy River Basin.

USE BY INDIANS

> *"From time before history the Indians had roved the wilds, fished the rivers, garnered the natural vegetables and fruits, and hunted game for food and clothing (Lynch 1973)."*

Indians and other native people lived along the lower Columbia River as early as 10,000 years ago. Evidence found by archaeologists shows that these early residents of the area inhabited the lower Columbia floodplain, especially near The Dalles area, which lies east of the mouth of the Sandy River on the Columbia and eventually became an important trade center (USFS 1993). Signs of their presence in the northern Oregon Cascades also date back at least 8,000 to 10,000 years (Burtchard et al. 1993). These early residents were often transient, moving through the region with the different harvest seasons. They gathered huckleberries and other food on upland meadows, fished for salmon, and hunted elk and deer.

Indian people also peeled bark from trees for making baskets, clothing, bandages and other items. Research suggests that the Indians established their villages on floodplains and traveled in small groups to upland harvest areas. Thus, while no evidence exists, it is highly likely that Indians from the lower Columbia River made trips up the Sandy River (USFS 1996). Traces of these early inhabitants include the petroglyphs carved into the basaltic rocks of the Columbia River Gorge.

Within the last few thousand years, the Indians built a trail network that extended across the Cascade Range around Mt. Hood. The travel route provided access to and from the trading center, Wascopam, near The Dalles that attracted Indians from around the region, including the Willamette Valley (USFS 1993). One popular trail extended up the Sandy River and over Lolo Pass. Another early trail, which later became the Barlow Road, joined the trail to Lolo Pass near the confluences of the Zigzag, Sandy and Salmon rivers (USFS 1996). The Indians would return by the same trails to their harvest areas year after year. Large mortars, too heavy to carry, have been found at the old campsites along Cedar, Eagle and Deep creeks (Strong 1973). Indians from villages along the Columbia, Clackamas and other rivers also boated to the Sandy River area to harvest salmon, berries, nuts and roots.

SETTLEMENT AND USE BY EUROAMERICANS

The interior valley of the Columbia River Basin, including the Sandy River drainage, remained largely unexplored by Europeans and Americans until Lewis and Clark came over the Rockies in 1805. Explorers visited the Sandy River Basin periodically in the early 1800s. They would boat up the river or follow the old Indian trails into unexplored country, as they knew the best paths would have been found over the years. Trappers also visited the area, but their use was limited since trapping was more plentiful in the Willamette Valley.

Daniel Lee, son of missionary Jason Lee, made one of the first documented visits to the area. In 1838, Daniel Lee followed the existing trail over Lolo Pass when he drove cattle from a Methodist mission in the Willamette Valley to a newly established mission at Wascopam. The trail was subsequently used by other pioneers to drive their livestock over the Cascades. The first wagons arrived over the Cascades in 1840 (Lynch 1973).

In 1843, the great immigration to the Oregon Territory began. The Barlow Road, following an old trail, opened in 1846 and soon became a popular route for bringing emigrants across the Cascades. A branch of the Barlow Road followed the ridge called Devil's Backbone between the Sandy and Little Sandy basins to the northeast corner of Roslyn Lake. Most emigrants headed for the rich agricultural lands in

the Willamette Valley, but some settled on lands along the Sandy River. As the area grew, many old Indian trails became roads. Some of these roads, called "corduroy" roads, were widened and covered with split logs laid crosswise (Lynch 1973).

Access to the Bull Run River[1] area improved in 1887 when the city of Portland began investigating the river as a main source for the city's water supply. A small community, "Unavilla", was established in the area around 1893. The name of the community was changed to Bull Run in 1895 (McAurthur 1982). The 1915 *Oregon Almanac* describes the community as including about 100 residents who supported themselves through timber harvest, farming, dairying and raising potatoes. The community, situated on the Bull Run River and at the terminus of the Mt. Hood division of the Portland Railway Light and Power Company railroad, had privately owned electric lighting and water systems. It is described as surrounded by rich agricultural land (including a nearby large-scale commercial flower bulb farm, the Crissey "Gladiolus Farm"), beautiful forests and river scenery (EDAW 1998). Today, the community of Bull Run remains an unincorporated town within Clackamas County.

The development of areas east of the Cascades for agricultural use spurred activities in the Sandy River Basin. Demand grew for a better transportation corridor over the mountains, and the Barlow Road was improved from a one-way, east-to-west route to allow two-way traffic. As traffic increased along the road, entrepreneurs moved into the area to provide accommodations and other services for the travelers. New settlers established homesteads along the road and in the lower Sandy River valley, particularly near the present cities of Sandy, Gresham and Troutdale. The Sandy post office was established in 1873 (McAurthur 1982).

At the turn of the century, most of the Sandy watershed remained a remote wilderness area and trails were the primary source of access to the upper basin. Thus, when the Mt. Hood Railway and Power Company began work on the Bull Run hydroelectric project in 1906, it had to develop road and then rail access to the site. Initially, it took three hours by stage to get to Bull Run from the electric interurban depot at Boring. The roads from Sandy to Bull Run, and from Bull Run to the Marmot Dam area had to be planked during periods of heavy rain to support traffic. Travel conditions improved in June 1911 when the railroad was completed, running 20 miles from Montavilla to the Bull Run powerhouse. The Portland Railway, Light and Power Company electrified the route in 1913 from Montavilla to Ruby Junction on the Troutdale line.

1 McAurthur, author of "Oregon Geographic Names", suggests that the name Bull Run River "may have started from the presence of wild cattle on that river in the pioneer period (1849-55). Cattle escaped from immigrants . . . and ran wild a number of years".

Development of the railroad line lured more people to the area. As discussed below, regular rail service between Portland and Bull Run made it easy for residents to transport timber, farm crops, livestock and other products to city markets.

> *Cordwood, brick, fir logs, gravel, and crushed rock were imported from along the Springwater and Mt. Hood divisions, which extended to Troutdale, Gresham, Cazadero and Bull Run. Perishables — fruits, vegetables and dairy products — were soon hauled into the city this way, opening new markets for surrounding farmers. Businesses in smaller cities prospered as the system provided same-day service for supplies (PGE 1989).*

Public demand for access to recreational areas in the upper watershed led to the completion of the Mt. Hood Loop Highway by the 1920s. The road brought new recreational areas within reach of area residents. The rail line was abandoned in 1927 as more areas became accessible by roads and people began to travel mostly by auto.

The basin's population expanded rapidly after 1950. Road improvements and the expansion of the transportation network provided better access, especially to lands in the upper watershed. Forest Road 18, built in the 1950s, connected Highway 26 to Hood River County and allowed construction of the Big Eddy/Troutdale transmission line from The Dalles Dam. The road also provided better access to the Bull Run watershed. Road 18 became a primary road on the Mt. Hood National Forest, carrying visitors to campgrounds, trailheads and other locations.

Improved access also attracted new residents. People found they could live in the basin's beautiful mountainous and rural settings, and commute to jobs and city life in the close by Portland metropolitan area. As a result, the area's population continued to grow. The 1990 census data revealed a 9 percent population jump from 1980 within the Mt. Hood corridor — which stretches from Brightwood up to Government Camp. During the decade, a 41 percent increase in housing units also occurred (USFS 1996).

TIMBER HARVEST

By the mid-1800s, settlers in the Willamette Valley began looking toward the Cascades to meet increasing demands for lumber, firewood and other resources. The demand for timber, particularly in the booming Portland metropolitan area, brought extensive timber harvest to the more readily accessible parts of the Sandy watershed.

Timber harvest in the lower basin began by the late 1850s. The first mill in the basin was built on Cedar Creek in 1858 and another mill was built soon after on Deep Creek (Strong 1973). Many logged areas, such as near the community of Sandy, were later cleared and cultivated for agricultural use or as private tree farms.

Logging intensified in the early 1900s, and by 1907 many sawmill operations existed in the lower Sandy River Basin. These early sawmill operations sprung up around the areas of Sandy, Firwood, Dover, Eagle Creek, Boring, Marmot, Pleasant Home, Welches and Brightwood. In 1907, a mill built on Tickle Creek south of Sandy was one of the first large mills to be built within walking distance of the town of Sandy (Strong 1973). When possible, many early loggers floated the wood downstream to mill sites and markets.

Arrival of the railroad allowed logging activities to expand further in the lower basin and into higher elevations, including the Cedar and Badger creek drainages. Logging companies constructed railroad spurs reaching as far as the headwaters of Cedar Creek. This allowed some loggers to ship their logs by rail.

Beginning in the 1950s, the Forest Service constructed a number of roads to reach timber in the upper watershed. It built about 48 miles of road to provide access to Wildcat Creek/Wildcat Mountain, Alder Creek and other higher elevation areas. It also built roads to reach timber in the lower watershed and along the north and south forks of the Sandy River.

Road construction in the watershed continued after 1960. The Forest Service built about 26 miles of new road in the upper Sandy watershed during the 1960s, including Forest Road 2609, which provided access to Cedar Creek. It also built several secondary roads into the Lost Creek and Horseshoe Creek drainages. More roads were built in the upper watershed through the 1980s, including 25 miles of road into the middle Clear Fork drainage during the 1970s and another 16 miles near Cedar and Alder creeks and into the Wildcat and North mountains during the 1980s.

Major road development also took place after 1960 in the Bull Run watershed. During the 1960s and 1970s, the Forest Service constructed nearly two-thirds of the forest roads now existing in the Bull Run drainage — more than 170 miles. The Forest Service built most of the mainline roads in the watershed during the 1960s and expanded from them in the 1970s. It added another 12 miles during the 1980s and 1990s. Currently, the Bull Run watershed contains 320 miles of road.

Road construction and timber harvest practices over the years damaged fish habitat in the basin. In the early years, valuable timber covered much of the watershed and harvest was generally unrestricted. Consequently, harvesters located their operations along streambanks where logs could easily be floated downstream to mills. Logging in riparian areas was common until the 1970s when scientists recognized the importance of riparian vegetation in maintaining healthy river systems. Timber was also removed from many accessible sensitive slopes. In addition, downed wood and boulders were regularly removed from navigable waters to ease the driving of logs downstream.

Reports published by Oregon's Master Fish Warden describe extensive logging in the basin. An agent for the Salmon River Hatchery wrote:

> *"at one time, this station was one of the best we had, but for the past few years it has succeeded in taking but a small number of eggs. There is so much logging done on the Sandy River . . . that I am sure the salmon are kept out of the stream (Oregon Department of Fisheries, 1909)."*

Another report written in 1911 states:

> *"as a large amount of saw mills and logging camps have operated on the Sandy River for years past, preventing the salmon from entering the stream, the number of eggs secured does not justify the expense of maintaining the hatchery. Next year I will move further downstream where an eyeing station will be located (Oregon Department of Fisheries, 1911)."*

Other reports discuss the effect of such activities on water quality. In 1890, sawdust and other mill waste were common pollutants in any stream in the state (Oregon Fish Commission 1889-1890).

Extensive road construction and timber harvest in the upper Sandy watershed after 1950 damaged fish habitat in many stream reaches. The roads increased soil erosion and carried sediment to stream channels where it filled pools and clogged spawning gravels. Other damage resulted when road culverts became blocked with debris or otherwise barred fish from reaching spawning grounds. Road construction and timber harvest also altered natural hydrological conditions by increasing surface runoff.

Today, timber harvest continues to be one of the most important industries in the area. However, harvest practices have improved. Current harvest and regeneration techniques are designed to reduce impacts on the watershed. For example, the treatment of harvest areas improved in the mid-1980s when forest personnel began applying new methods to increase new tree growth and survival. These methods included using fertilizers and planting higher quality trees in harvested areas.

Still, timber-related activities over the past 100 years caused significant changes in the Sandy River watershed. Intense timber harvest and road building in the upper and middle basin created large open patches that now dominate the structure and function of the landscape. In addition, riparian areas are often smaller, contain fewer diverse vegetative communities, and provide less of a buffer against high streamflows (USFS 1996).

MINING

Sand and gravel operations, particularly along the lower Sandy River, occurred periodically for many years. Generally, these operations changed conditions within the mined stream reaches. They affected fish production and reduced habitat complexity through removal of undercut streambanks, degradation of channel stability, extraction of spawning gravels and by creating barriers to migration. Mining in the delta area stopped when it became part of the Columbia River Gorge Scenic Area.

AGRICULTURE

During the mid- to late-1800s, new settlers began cultivating the lower basin's rich stream bottom land, fertile plateaus and rolling hills. By the late 1800s agricultural use was common in the lower basin below the town of Sandy and along the plateaus of the lower Sandy River and tributaries such as Beaver Creek. Early farmers grew vegetables, berries, fruits and grain and often sold their products in Portland area markets.

Over the years, the lower basin has continued to support agricultural uses. However, in addition to producing vegetables, berries, fruits and grains, farmers also grow ornamental plants and trees. Further, many once productive parcels of agricultural land have been converted to residential or commercial use to support the area's growing population.

Cultivation of lands in the lower basin for agricultural use impacted habitat conditions along the lower river and tributaries. Conditions in the lower watershed changed as wetlands and floodplains were drained and filled. Stream stability and habitat diversity were also affected by removal of riparian vegetation and, in some drainages, streamflows for irrigation purposes. Such impacts are evident along Beaver Creek, a large lower basin tributary.

RECREATION

By the mid-1800s the peaks of Mt. Hood were already challenging early mountaineers. Government Camp, a campground for pioneers after Samuel Barlow left wagons there in 1845, became the starting

point for many Mt. Hood climbers. Joel Palmer reached the top of the mountain in 1845. Many other climbers soon followed in his footsteps. During an outing in July 1896, a group of about 350 climbers from all over Oregon met at Government Camp. They traveled to the camp in four-horse-drawn coaches. Before cars, travelers to Government Camp followed Foster Road to Sandy, dropped down to cross the Sandy River, climbed up a hill on the river's other side just below the Devil's Backbone to Marmot, and then went through Cherryville, Brightwood, Wemme, Zigzag, Rhododendron and up Laurel Hill to the mountain (Lynch 1973).

Recreation continued to grow in the 1900s with expansion of the railroad. Roads generally remained in poor shape, but the railroad provided relatively quick and comfortable transportation to recreation sites. For instance, people from the Portland areas could take the trolley to Bull Run Park[2] (Dodge Park) at the confluence of the Bull Run and Sandy rivers and return home that evening. Thus, the park received heavy use, particularly on weekends. According to one report,

> *"a conservative estimate of visitors during the last summer would be thirty thousand . . . at times there was hardly room enough to accommodate the crowds that poured into the park on Sundays . . . hundreds enjoyed swimming in the hole below the bridges" (Portland Bureau of Water Works 1926).*

The turn of the century also saw more visitors to the white peaks of Mt. Hood. However, before the late 1920s — when car access improved — recreational use in the upper watershed was limited. A trip to the Government Camp area, a popular destination, remained long and tiresome until the 1920s when the Mt. Hood Loop Highway was completed. Once the highway was built, summer and weekend visitors came to picnic and explore the area. Recreation facilities improved in the 1930s when the Civilian Conservation Corps (CCC) and the Works Progress Administration (WPA) built campgrounds and trails in the watershed. Several summer cabins were also built in the forest at this time. Generally, however, activities in the upper Sandy watershed remained limited by the lack of access until after 1950 when the road network in the forest was expanded.

MUNICIPAL WATER SUPPLY DEVELOPMENT

In 1891, the city of Portland — which had grown into a thriving metropolis — began efforts to secure a continuous supply of clean water from the Bull Run River, a pristine tributary of the Sandy River. President Benjamin Harrison established the Bull Run Reserve in 1892, protecting the high-quality supply of potable drinking water for Portland. On January 1, 1895, the city finished building its first conduit and

2 The park was originally known as Bull Run Park, but was renamed Dodge Park in 1918 in honor of Frank T. Dodge of Portland's Bureau of Water Works.

water diversion at the site of the present Headworks Dam (RM 6) on the Bull Run River and started transferring water to Portland.

The city built several new structures in the Bull Run watershed in the early 1900s. In 1911 it completed a second conduit to carry Bull Run water to Portland. Then, in 1915 it built a 10-foot-high rock and log crib structure at the outlet of Bull Run Lake, a natural water body in the headwaters of the Bull Run watershed. The structure raised the lake's storage capacity to about 4 billion gallons of water. In 1922, the city built Headworks Dam, 20 feet high with no fish passage facilities. It constructed a second dam, the Ben Morrow Dam (Bull Run Dam No.1), in 1929 near the confluence of Bear Creek and the Bull Run River (RM 11). The structure, about 200 feet high, impounded about 10 billion gallons of water. The city also built a small reservoir, Boody Lake, on the North Fork of the Bull Run River near the headwaters that stored about 0.4 billion gallons of water.

Early records do not discuss whether the dam built in 1895 on the lower Bull Run River hindered salmon and steelhead migration. However, biologists generally believe that many fish could have passed over the dam, which stood less than 10 feet high. This migration ended in 1922. Since then, Headworks Dam (RM 6) has blocked all salmon and steelhead access to the upper Bull Run system, about 37 miles of high-quality habitat in the mainstem and tributaries. In addition, water diversions at Headworks Dam have damaged habitat conditions in the six miles of free-flowing river below the dam. The diversions reduce flows in the lower Bull Run River from late spring to fall, and limit recruitment of gravel and large woody materials that had once created healthy, diverse fish habitat.

HYDROELECTRIC DEVELOPMENT

Incredible population and industrial growth in the Portland metropolitan area during the early 1900s created a hunger for a larger electric power supply. Power was needed to fuel the extensive system of interurban railroads and trolleys spreading south from the Columbia River to Salem in the middle Willamette Valley. The region also needed power to bolster growing industrial and residential developments. Electric requirements increased at a rapid rate and low-cost hydroelectric generation became more attractive for bulk power supply.

Hydro developers directed their attention to the Sandy River at the turn of the century. Hydroelectric power development on the Sandy and Little Sandy rivers began in September 1906, with the incorporation of the Mt. Hood Railway and Power Company (Mt. Hood Company). Actions by this company soon ignited the competitive interest of two other companies, the Portland and Sandy River

Electric Company and the United Railways. Following the Mt. Hood Company's lead, these companies quickly began investigating potential hydropower sites on the Sandy River. The investigations led to the development of several hydropower projects on the Sandy. The projects are discussed briefly below.

Bull Run Project

In 1906, the Mt. Hood Company started work on the Bull Run project. This project included construction of a powerhouse on the lower Bull Run River (RM 1.5) and a diversion dam on the Little Sandy River (RM 1.7), a tributary of the lower Bull Run River. The Little Sandy diversion dam stood about 16 feet high and diverted water through a 17,000-foot-long wood box flume to Roslyn Lake, which covered approximately 140 acres and formed the forebay for the Bull Run Powerhouse. The Mt. Hood Company began operating the powerhouse on Little Sandy River water in 1912. That same year, it merged with the Portland Railway Light and Power Company, Portland General Electric's predecessor.

Construction and operation of the Little Sandy diversion dam reduced natural fish production in the Little Sandy River, a system that is believed to have once contained good anadromous fish habitat. The diversion dam blocked salmon and steelhead access to about 6.5 miles of habitat above the dam. It also reduced streamflows in the 1.7-mile reach between the dam's lower end and the river's confluence with the Bull Run River.

Marmot Dam

In 1913, the company completed construction of Marmot Dam on the Sandy River (RM 30). The 30-foot-high dam diverted water from the Sandy River to the Little Sandy River via a network of canals and tunnels. The longest tunnel, 4,690 feet, ran under a mountain ridge connecting the two basins.

That year, the company started diverting up to 600 cubic feet per second (cfs) of water from the Sandy River to the Little Sandy River just above its diversion dam. The combined waters were then diverted to Roslyn Lake through a wood box flume that ran along the Little Sandy River's south bank and carried up to 800 cfs of water.

Upon completion, Marmot Dam was provided with a wooden fish ladder. However, the ladder entrance was damaged by flood water during its first season of use and the company had to extend the entrance upstream. Floods in the following years repeated the damage. The company regularly repaired and improved the ladder, though it was being used extensively to trap adult salmon and steelhead for hatchery production. Correspondence between the company and state fishery managers suggests that the game

warden wanted the ladder to permit fish migration over the dam, but the fish warden wanted modifications to help the capture of fish for hatchery purposes. A fish and game commission report on the repair problem, for instance, referred to a Deputy Fish Warden *"who has charge of the hatchery work below your dam."* The company received another letter from the Master Fish Warden in July 1913 that referred to *"the superintendent of our egg taking station at your dam on the Big Sandy."* However, a letter from the Fish Warden the following March commented on high water damage requiring *"that immediate steps are taken to repair this fishway . . . so that the fish will be able to reach the water above the dam (PGE 1982)."*

Between 1913 and 1933, the company rebuilt and improved the ladder often to enhance fish passage. In 1918, the company reconstructed 15 pools at the lower end of the ladder and reinforced them with concrete. It also rebuilt and improved the upper 16 wooden pools. In 1926, the company installed two concrete pools at the lower end of the ladder and raised the wall height on the previously installed 15 pools. The remaining wood sections were replaced with reinforced concrete pools in 1930. By 1933, improvements to the fishway had cost 13 times that of the original structure. While these changes improved fish passage at the dam, egg-taking operations at or below Marmot Dam until the early 1950s, ladder damage, and low flows persisted in hindering fish migration to the upper basin through the 1950s.

More changes took place in the 1970s. In 1971, the company installed an exit gate to the ladder with a submerged weir that adjusted to the rise and fall of the river level and stopped bed load from entering the ladder. Then in 1974, upon request by Oregon's fish and game commissions, the company began leaving more water in the Sandy River below Marmot Dam to improve fish passage and increase rearing area in the lower Sandy River.

Portland General Electric continued to improve the fish passage facilities. In 1983, the company upgraded the fish ladder on the south bank of Marmot Dam for upstream fish passage. It also installed a fish counter at the facility to provide daily fish counts. This counter was replaced in 1996 when the previous counter was determined unreliable. Because of these changes, Marmot Dam's fish ladder now allows adequate upstream fish passage (ODFW 1997).

Over the years, efforts have also been made to reduce impacts on downstream migrants, which were often swept into the Sandy River diversion canal. In 1948, Oregon's fish and game commissions asked the company to install screens in the diversion canal to prevent downstream migrants from reaching Roslyn Lake. The company soon began engineering and design studies. The screen became operable in 1951

and has been improved several times over the years. The downstream juvenile bypass system was further improved in the 1980s. Ten collection ports in the side walls and in the metal beams separating the screens diverted the fish into a chamber under the screens and then into a pipe. The pipe, about 36 inches in diameter and 200 feet long, emptied into a plunge pool near the shoreline of the Sandy River below Marmot Dam. Water from the plunge pool directed the fish into the Sandy River or into a trap where biologists could monitor juvenile downstream fish passage.

Today, the company continues to monitor salmonid mortality and effects on migration at the project's facilities. Because of these studies, conducted in coordination with fish managers, the bypass system has been modified several times. The company has placed baffles upstream from the screens to provide a uniform flow at the screen surface. It has also refinished the inside of the transport pipe, deepened the plunge pool, built a trap and enlarged the bypass ports to increase the flow of water through each port.

Dam operations have also been adjusted to maximize fish survival at the rotating screens and downstream juvenile bypass facility. Currently, the bypass system is operated under the following criteria:

- The fish bypass operates on a continuous basis whenever water is diverted into the canal.
- Canal screens run all year, but are rotated from March 1 through May 31 when fry are present.
- Screen wash spray pressure is kept at 30 psi from March 1 to May 31.
- Bypass flow is maintained at 60 cfs so water enters ports at 2 feet per second.
- When many smolts are observed in front of the screens, canal flows are lowered to flush fish through the bypass and back into the river.

Studies of the downstream juvenile migrant bypass facility at Marmot Dam show that survival is now high. Cramer (1993) concluded that, though the proportion of downstream migrants diverted into the canal is unknown, an estimated 95.4 percent of the fry (fish smaller than 50 mm) that enter the bypass facility survive. When biologists released hatchery smolts into the system, they found that about 97.3 percent of the steelhead test smolts and 95 percent of the spring chinook test smolts survived passage through the bypass system. Survival of wild steelhead smolts was near 99 percent, though there were not sufficient numbers for a full test. Today, the company continues to address remaining concerns to improve downstream migration through the bypass system. Most recently, in 1998 the company added a new surface collector system for fry. The effectiveness of this system is presently being evaluated.

FISH HARVEST

Salmon and steelhead runs to the Sandy River began dropping by the late 1800s with the expansion of the fishing industry. Fishing parties on the Columbia and lower Sandy rivers caught scores of fish bound for the basin's spawning grounds.

In the early days, harvest focused on spring chinook. Commercial harvest of spring chinook began on the Columbia River in the mid-1800s and grew quickly until it peaked around 1873 with a take of about 43 million pounds (Oregon Game Commission 1951). Spring chinook harvest on the Columbia then declined significantly, suggesting that the river's spring chinook run had already been weakened by overharvest. Records show that in 1877 more than 1,000 drift nets were in the Columbia, each 1,200 feet long (U.S. Commission of Fish and Fisheries 1877). Commercial gear regulations were not adopted on the Columbia until 1878.

Heavy fishing on the Columbia River persisted into the 1900s, but an important change took place. Commercial fisheries continued to harvest about 25 million pounds of fish each year until 1922, but spring chinook made up less and less of the catch. Around 1880, spring and summer chinook salmon runs started declining and harvest shifted to fall chinook salmon. By 1912 spring and summer chinook comprised 75 percent of the fish in the harvest and by 1920, the catch was estimated to be 50 percent fall chinook (Lichatowich and Mobrand 1995). Harvest emphasis also moved to steelhead (1890 to 1900) and then to coho (1920s). Peak commercial catches for chinook and coho occurred in 1883 and 1925, respectively (Lichatowich and Mobrand 1995). Generally, commercial harvest of all species declined steadily after 1923, with an average annual harvest of 15 million pounds from 1923 to 1958 (Lichatowich and Mobrand 1995). By 1945, production of all species had declined significantly.

Many other salmon and steelhead from the Sandy River were harvested in ocean fisheries. In 1912, the ocean troll fishery (towing a hook and line behind a boat) began competing with the Columbia River fishery. The troll fishery initially began off the mouth of the Columbia River. The number of boats doubled from about 500 in 1915 to about 1,000 in 1919 (Northwest Power Planning Council 1987). The ocean troll fishery expanded through the 1920s and peaked in the mid-1930s. During this time, it took a significant portion of the fall chinook, spring chinook and coho destined for the Columbia River Basin (ODFW 1997). Until 1948, there were few restrictions on the ocean fisheries.

Ocean and Columbia River fisheries expanded again in the early 1960s when the wild salmon and steelhead production of the previous decades was replaced by improved hatchery production. The

fisheries climbed significantly in the 1970s, but have steadily declined since then (ODFW 1997). Some fisheries continued to affect Sandy River runs into the 1990s. Coho harvest records, for instance, show that before 1993 commercial fisheries in the ocean and Columbia River intercepted many Sandy Hatchery coho. For the 12-year period 1981-1992, total ocean commercial harvest of Sandy Hatchery coho averaged about 19,170 fish annually, about 43.5 percent of the total Sandy Hatchery coho available (ODFW 1997).

Today, fisheries outside the basin continue to harvest many Sandy River salmon and steelhead. Harvest rates and overall contribution of Sandy River spring chinook to various fisheries outside the basin are unknown, but are believed to resemble harvest rates on Willamette basin stocks. Records show that approximately 67 percent of the Willamette spring chinook harvested in ocean fisheries are caught in British Columbia and about 33 percent are caught in southeast Alaskan waters (ODFW 1997). Out-of-basin fisheries also harvest many Sandy River fall chinook. In addition, studies suggest that commercial and sports fisheries outside the basin, including ocean fisheries, may harvest up to 50 percent of the native fall chinook run destined for the Sandy River based on harvest rates reported for wild fall chinook from the Lewis River, a lower Columbia River tributary in Washington (brood years 1982-87: adult return years 1984-93) (ODFW 1997).

Salmon and steelhead runs have also been targeted for harvest in the Sandy River. While the river system has always attracted anglers, fishing for spring chinook on the lower Sandy grew in popularity during the late 1800s and early 1900s as the region's population expanded. The development of the railway, roads and easily accessible sites, such as Dodge Park, on the lower Sandy River created more fishing opportunities. Fishing pressure in the basin continued to grow for many years as the region's population expanded and the construction of new roads provided better access.

Present salmon and steelhead runs still support popular sport fisheries in the Sandy River Basin. In-river sport coho harvest data shows that sport anglers caught an estimated average of 1,263 coho annually in the Sandy River for the 12-year period 1981-1992. Sandy River spring chinook also support a substantial sport fishery in the river, primarily below Marmot Dam (RM 0-30). This fishery has increased in parallel with hatchery smolt releases in the basin over the last 15 years. Fall chinook fishing in the Sandy River Basin is generally limited by natural conditions, since by the time the adults return to the river to spawn, their condition and meat quality has deteriorated.

Winter steelhead continue to be the most popular game fish in the Sandy River. Before catch-and-release regulations were started in 1990, in-basin harvest of winter steelhead significantly affected spawning and escapement of wild winter steelhead into the upper basin. Today, hatchery winter steelhead are released at popular angling spots such as Oxbow and Dabney parks on the lower river. Such releases concentrate adult returns in the areas where most harvest takes place and protect the native stock from competition in important upper basin spawning and rearing areas.

SUMMARY

The Sandy River Basin has seen significant changes since the middle 1800s. Over the last 150 years, large amounts of timber have been removed from basin forests. Other lands have been cultivated for agricultural production or otherwise developed to accommodate increasing residential and industrial growth. The Sandy River and many tributaries have also been transformed. Since the mid-1800s, human efforts to extract and harness resources have disturbed natural stream hydrology, streamflow patterns, channel structure and water quality within the Sandy River system. Human impacts include the building of dams, removal of streamflows, stream channelization, extraction of instream gravels and downed wood, loss of riparian vegetation, and the destruction of side channels and wetlands. Together, these changes have contributed to dramatic losses of salmon and steelhead habitat and productivity. Basin salmon and steelhead runs have also been greatly reduced by harvest activities in the Columbia River, ocean and Sandy River.

The following sections discuss salmon and steelhead production in the Sandy River basin through the years. Human activities and developments discussed in this section directly influenced these runs and actions taken to improve them. Consequently, the key events that shaped conditions in the drainage during each period are often mentioned in the discussions and are summarized at the end of each section.