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29 Upper Columbia Subbasin Overview[1]

29.1 Regional Context for the Upper Columbia Subbasin

The Upper Columbia Subbasin is one of six subbasins located in the northwest region of the IMP. The Subbasin is bound to the west by the San Poil Subbasin, to the east by the Pend Oreille Subbasin, to the south by the Spokane Subbasin, and to the north by the Canadian border.

29.2 Upper Columbia Subbasin Description

29.2.1 Drainage Area

The Upper Columbia Subbasin incorporates five water resource inventory areas (WRIA) as designated by Washington State's Department of Ecology (WDOE): Lower Lake Roosevelt (WRIA 53), Middle Lake Roosevelt (WRIA 58), Colville (WRIA 59), Kettle (WRIA 60), and Upper Lake Roosevelt (WRIA 61). The 74,000 square-mile Subbasin includes waters within the Colville and Spokane Indian Reservations, and Stevens, Lincoln, Ferry, and Okanogan counties in Washington (Delorme 1988). Major tributaries within the Upper Columbia Subbasin include the Colville and Kettle rivers and Big Sheep Creek. Significant lakes within the Subbasin include Loon, Waitts, Williams, Cedar, Deep, and the lakes of the Little Pend Oreille chain. Lakes of importance to the members of the Colville Confederated Tribes (CCT) include the following; North and South Twin, Owhi, Omak, Buffalo, Round, LaFleur, Nicholas, Borgeau, and Sugar lakes, and on the north half of the former reservation, Ellen, Elbow, Pierre, and Summit lakes.

[1] Portions of Section 29 were contained within the Upper Columbia Subbasin Summary Report (2000) pp. 1-4.

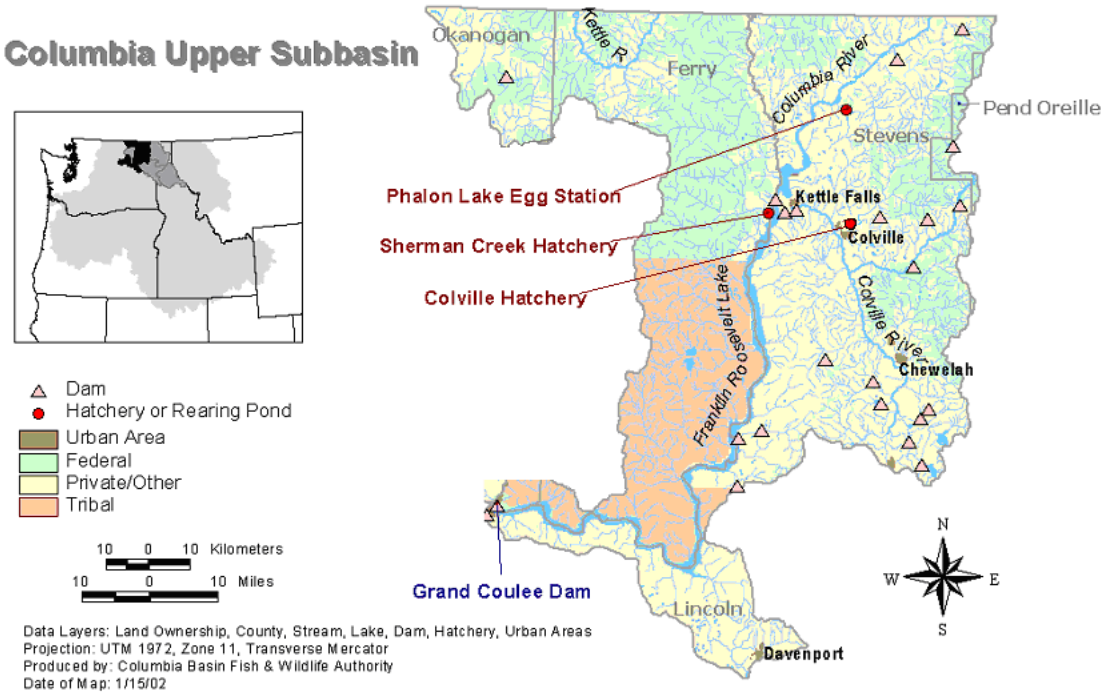

Figure 29.1. Upper Columbia Subbasin identifying land ownership

29.2.1.1 Lake Roosevelt

Grand Coulee Dam regulates Lake Roosevelt water levels between 1,208 level (minimum pool) and 1,290 feet mean sea level (full pool). The reservoir extends a total of 135 miles (217 km) upstream (USGS 2004), covers 82,300 acres, and stores approximately 9,562,000 acre-ft of water. When the reservoir was initially filled to full pool, over 70,000 acres of land was inundated (Merker 1993). The watershed area that comprises the Subbasin is approximately 2,411 square miles and includes 226 tributaries to the Reservoir (excluding the Spokane River, San Poil River, Colville River, and Kettle River).

29.2.1.2 Kettle River

The Kettle River winds its way through the Kettle Range of Washington and British Columbia in an easterly direction, turning south and entering Washington at Laurier. From Laurier it flows south and joins Lake Roosevelt at RM 706. Washington contains 1,023 square miles of the Kettle River drainage. The Kettle River has a mean annual flow of 12,000 cubic feet per second (cfs). Mean monthly flows for the periods of 1928 to 1949 and 1950 to 2002 for the Kettle River recorded near Ferry, Washington are displayed in Figure 29.2. A waterfall at RM 25 was a natural migration barrier to anadromous fish and is currently a natural migration barrier to adfluvial resident fish.

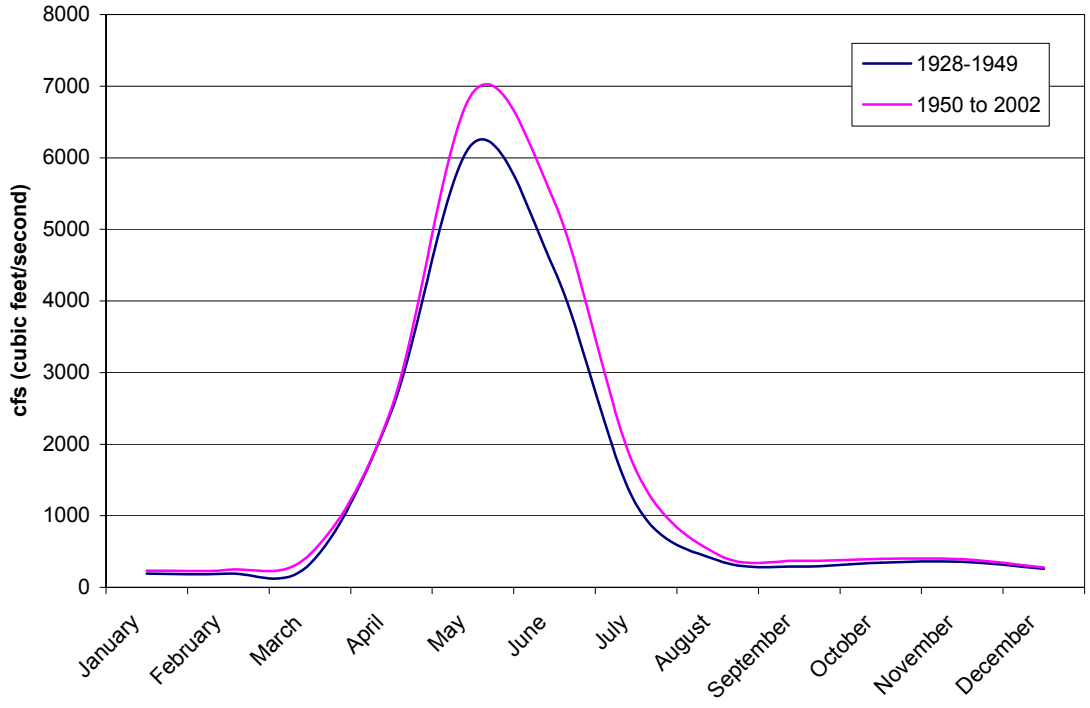

Figure 29.2. Kettle River mean monthly flow for the periods 1928-1949 and 1950-2002 recorded at the USGS gauge station near Ferry, WA

29.2.1.3 Colville River

The Colville River, which flows north through a wide valley dominated by agriculture practices, enters Lake Roosevelt at RM 699.5, just south of Kettle Falls. The Colville River drains an area of 1,010 square miles with a mean annual flow of 429 cfs. Mean monthly flow for the Colville River recorded near Kettle Falls, Washington is displayed in Figure 29.3 for the periods of 1922 to 1949 and 1950 to 2002. As a result of agriculture land uses, the aquatic and riparian habitat has been severely impacted. Meyers Falls at approximately RM 4 was a barrier to migrating anadromous fish and is currently a barrier to adfluvial resident fish species. The Colville River has three main population centers on it, Chewelah, Kettle Falls, and Colville, Washington.

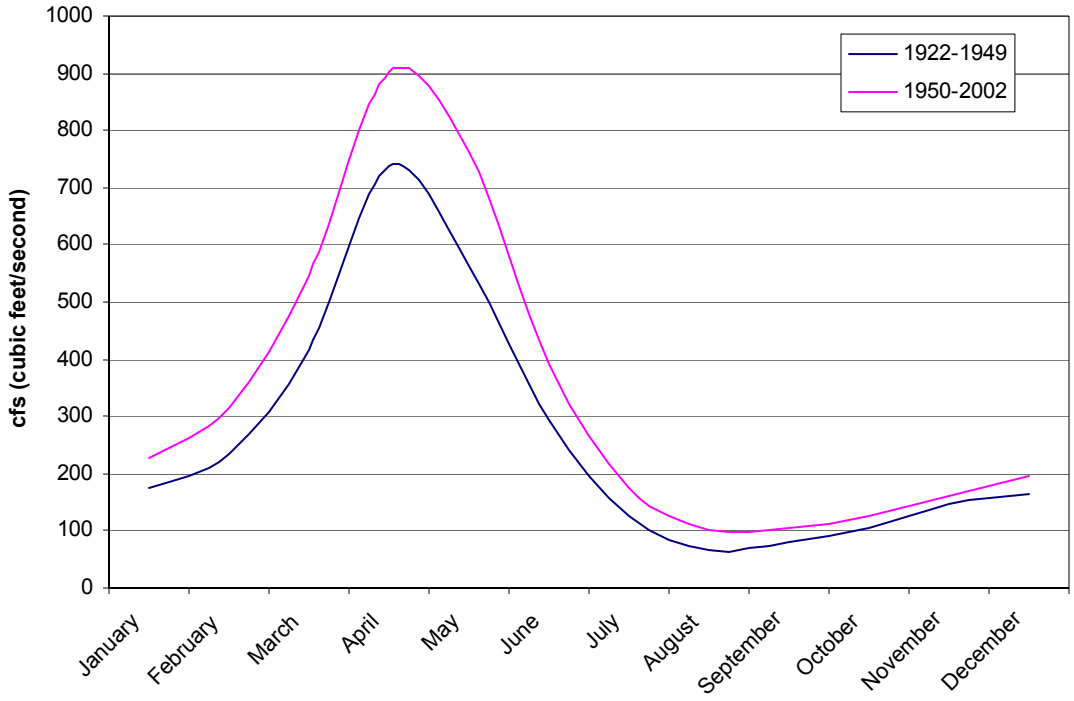

Figure 29.3. Colville River mean monthly flow for the periods 1922-1949 and 1950-2002 recorded at the USGS gauging station at Kettle Falls, WA

29.2.1.4 Banks and Moses Lakes

Although Banks and Moses Lakes were included in the Upper Columbia Subbasin Summary (2000), they were never part of the Upper Columbia Subbasin. For subbasin planning purposes, Banks and Moses lakes are being analyzed in the Crab Creek Subbasin. Although not part of the Upper Columbia Subbasin, the management of Banks and Moses Lakes are closely linked with the management of waters included in the Upper Columbia Subbasin, even though they are geographically distinct. In addition, the Banks and Moses lakes Projects (BPA No. 199502800) are mitigation for the Upper Columbia Subbasin.

29.2.2 Climate

The Subbasin has a continental climate that is influenced by maritime air masses from the Pacific coast. The average annual temperature is 7.2º C (45º F), with July being the warmest month and January the coldest. The annual precipitation for the area is 46 cm (18 inches), which includes approximately 117 cm (46 inches) of snowfall (The Weather Underground 2000).

29.2.3 Geology

The Upper Columbia Subbasin lies on four geologic provinces. The first is the old North American continent, comprising most of the Colville watershed. It is the oldest geologic province and is represented by a small part of the Rocky Mountains in the northeast

corner of Washington (Alt and Hyndman 1984). The ancient rocks of the continental crust are made up of granite, gneiss, and schist (Alt and Hyndman 1984). The second province is the old coastal plain that was at one time part of the western margin of North America. These layers of rock were pushed into tight folds, which are now seen as the Kootenay Arc. It is a belt of sedimentary rocks, tightly folded and littered with granite intrusions. Most of Lake Roosevelt lies within this province. West of the Kootenay Arc is the Okanogan subcontinent, which dominates the Kettle River watershed. It was an island about the size of California pushed against the sedimentary rock of the Kootenay Arc. The southern portions of all three provinces disappear beneath the Miocene basalt flows of the Columbia Plateau. It lies between the Cascade and Rocky Mountains and south of the Okanogan highlands. This area was built up by volcanic lava flows. The lava is made up of black fine-grained basalt. No place on earth has experienced basalt eruptions comparable in volume.

29.2.4 Soils

When describing soils, Lake Roosevelt and the Columbia River and its tributaries (Colville and Kettle rivers) lie on two separate distinct provinces. The first province in the north is the Okanogan Highlands. In this area, the soil pattern is closely tied with elevation. In mountainous areas, soils are derived from a granite parent material (Franklin and Dyrness 1988). The soils have a texture of gravelly sandy loam to silt loam and a depth of one meter or less. A substantial amount of these high elevation soils have a considerable amount of volcanic ash (Franklin and Dyrness 1988). At low elevation at the margins of river valleys, the most abundant parent material is glacial till. Textures of these soils are usually sandy loam to loam, and are moderately dark (Franklin and Dyrness 1988). The second province is the Columbia Basin Soil Province. The predominate soils here are derived from loess. These soils usually have a moderately thick brown silt loam horizon over a light-brown silt loam horizon with a prismatic structure beginning to appear (Franklin and Dyrness 1988).

29.2.5 Vegetation

Interior mixed conifer forests, ponderosa pine forests, eastside interior grasslands, and shrub-steppe habitats dominate vegetation in the Upper Columbia Subbasin. Vegetation assemblages transition from sagebrush-steppe communities in lower elevation areas to pine savannahs in mid-elevation areas. Montane mixed conifer forest, upland aspen forest, and lodgepole pine forests are present in the high elevations along with montane coniferous wetlands. Agricultural lands are present within the Colville River valley, on the plateaus above Lake Roosevelt, and in the extreme southern portion of the Subbasin. The largest urban areas within the Subbasin boundary include Chewelah, Colville, Kettle Falls, Davenport, and Grand Coulee.

Figure 29.4 shows the current distribution of wildlife-habitat types in the Upper Columbia Subbasin, as adapted from IBIS (2003). A map of the historic vegetation of the IMP, including the Upper Columbia Subbasin, is provided in Section 4, Terrestrial Resources of the Intermountain Province (Figure 4.1).

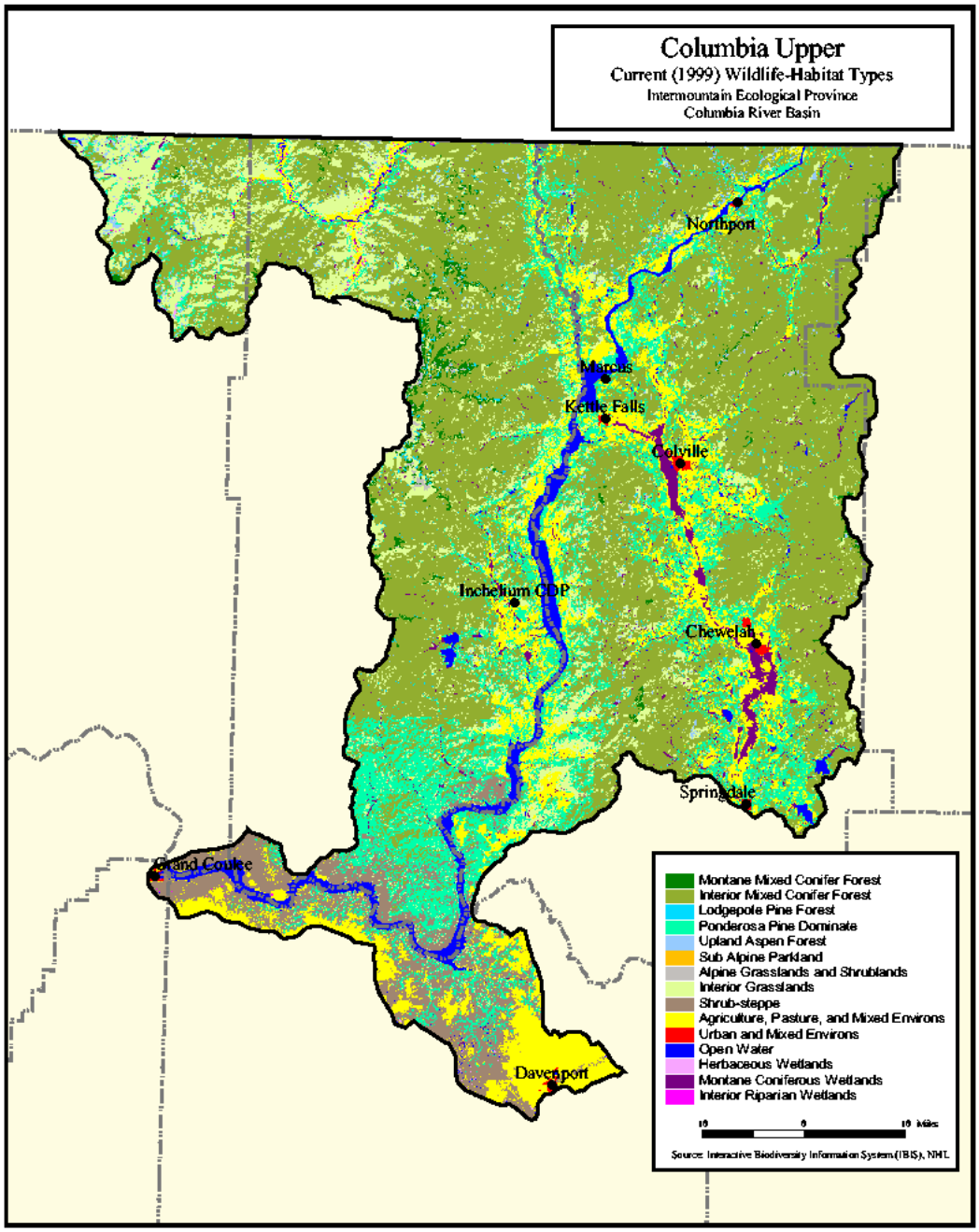

Figure 29.4. Wildlife-habitat types in the Upper Columbia Subbasin adapted from IBIS (2000)

29.2.6 Major Land Uses

Figure 29.1 shows the major land ownership categories within the Subbasin. Many different land uses exist within the boundaries of the Subbasin including cattle grazing, crop production, mining, and timber harvest. Overall the Subbasin is sparsely populated, although many urbanized areas exist.

29.2.6.1 Lake Roosevelt Area

A variety of land uses occur within the lands within the Columbia River Valley between Grand Coulee Dam and the U.S.-Canadian border. Agriculture, mining, timber harvesting, ranching, and urban uses all occur within the various counties that are adjacent to Lake Roosevelt. Dry land farming of barley and wheat are common to the south of the lake. Lincoln County is the nations second largest producer of wheat. In addition, lumber and pulp operations are present within the area, which stem from the local timber industry. Although the area is not densely populated, up to 1.5 million people visit Lake Roosevelt to recreate each year.

29.2.6.2 The Colville River Valley

The Colville River valley extends from Springdale, through Chewelah, Colville, and Kettle Falls and is dominated by small grain and hay crops. The farmed valley is 2 to 3 miles wide at its widest area near the towns of Valley and Chewelah. This area has a long history of intensive agriculture and dredging in the Colville River. A majority of the riparian habitat has been removed along the Colville River throughout this region.

As the Colville River flows north from Chewelah, it has a steeper gradient with some associated, at least shrubby, riparian habit. There are still a few significant cottonwood galleries and wooded oxbows that provide high-quality wildlife-habitat. Annual rainfall averages 18 inches in the valley and increases with elevation. Second and third growth coniferous forests dominate the landscape from the valley edge to the mountain ridges. Timber harvesting and significant expansion of human residences into the rural countryside has contributed to habitat fragmentation. Fire suppression and harvesting old-growth ponderosa pine have depleted natural grasslands and parkland pine forests (Steve Zender, District Biologist, WDFW, personal communication).

29.2.6.3 The Kettle River Drainage

The Kettle River drainage originates in British Columbia within the Okanogan Highland and Monashee Mountains, draining a watershed area of approximately 4,200 square miles upstream of its confluence with the Columbia River. The Kettle watershed in Washington state represents approximately 23 percent of the total watershed area of the River basin. The existing land use within WRIA 60 is primarily forest, both publicly and privately owned, with interspersed areas of forest-rangeland and agriculture. Approximately 75 percent of the watershed includes the federally managed Okanogan and Colville National Forests. Rangeland and agricultural areas are prominent within the corridors occupied by the Kettle River and its tributaries. These agriculturally based areas are composed of a variety of uses, including cultivated crops, grazing, and animal husbandry. Urban and developed areas are minimal and limited to small towns with populations less than 1,000 located along the Kettle River and several of its major tributaries.

29.2.6.4 Lake Roosevelt Shoreline Erosion

The shoreline of Lake Roosevelt extends approximately 530 miles, an estimated 70 percent of which consists of easily eroded unconsolidated sediments (USBR 2000). The sediments are alternately exposed, during winter reservoir drawdowns, and inundated during full pool operation. The combination of wave action and water fluctuations has contributed to slope failures of these inherently unstable soils at many locations around the reservoir. Figure 29.5 shows the portion of Lake Roosevelt located within the Upper Columbia Subbasin and highlights the areas of high erosion potential along the shoreline. Analysis of a 300-foot band upslope of the 1,290-foot elevation level shows that 14 percent of the area within the band has high erosion potential, while about 12 percent is composed of bedrock.

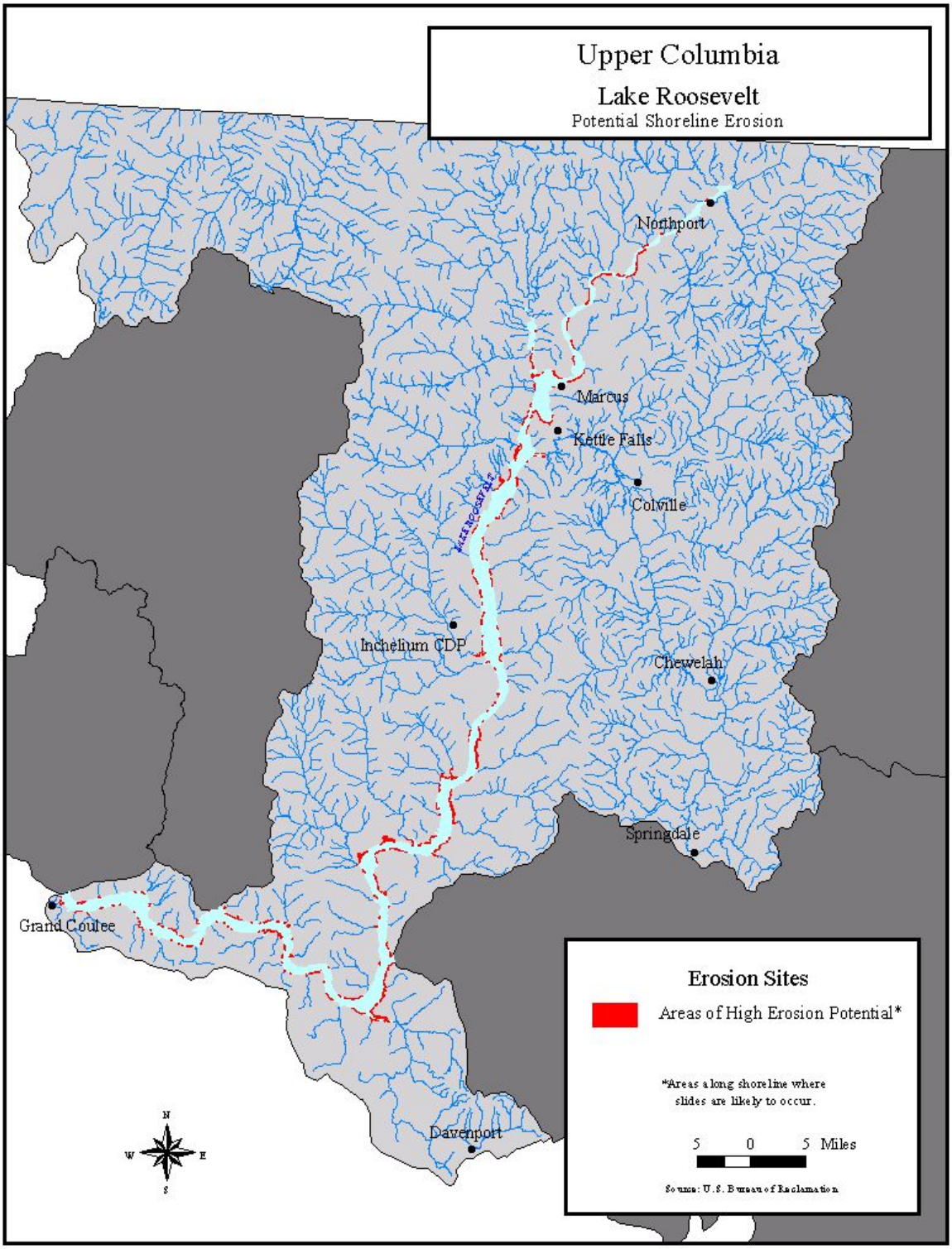

Figure 29.5. Areas of high erosion potential for portions of Lake Roosevelt located in the Upper Columbia Subbasin. Note: Areas of high erosion potential emphasized for display purposes and are not to scale.

29.2.6.5 Road Density

Figure 29.6 shows road density, by density class, for each sixth order watershed in the Upper Columbia Subbasin. The majority of the Subbasin is ranked as high road density (1.7 to 4.7 miles of road per square mile). Several watersheds in the southernmost portion of the Subbasin, in the eastern portion, and along Lake Roosevelt are ranked as moderate road density (0.7 to 1.7 miles of road per square mile). A single watershed in the vicinity of Davenport is ranked as low road density (0.1 to 0.7 miles of road per square mile).

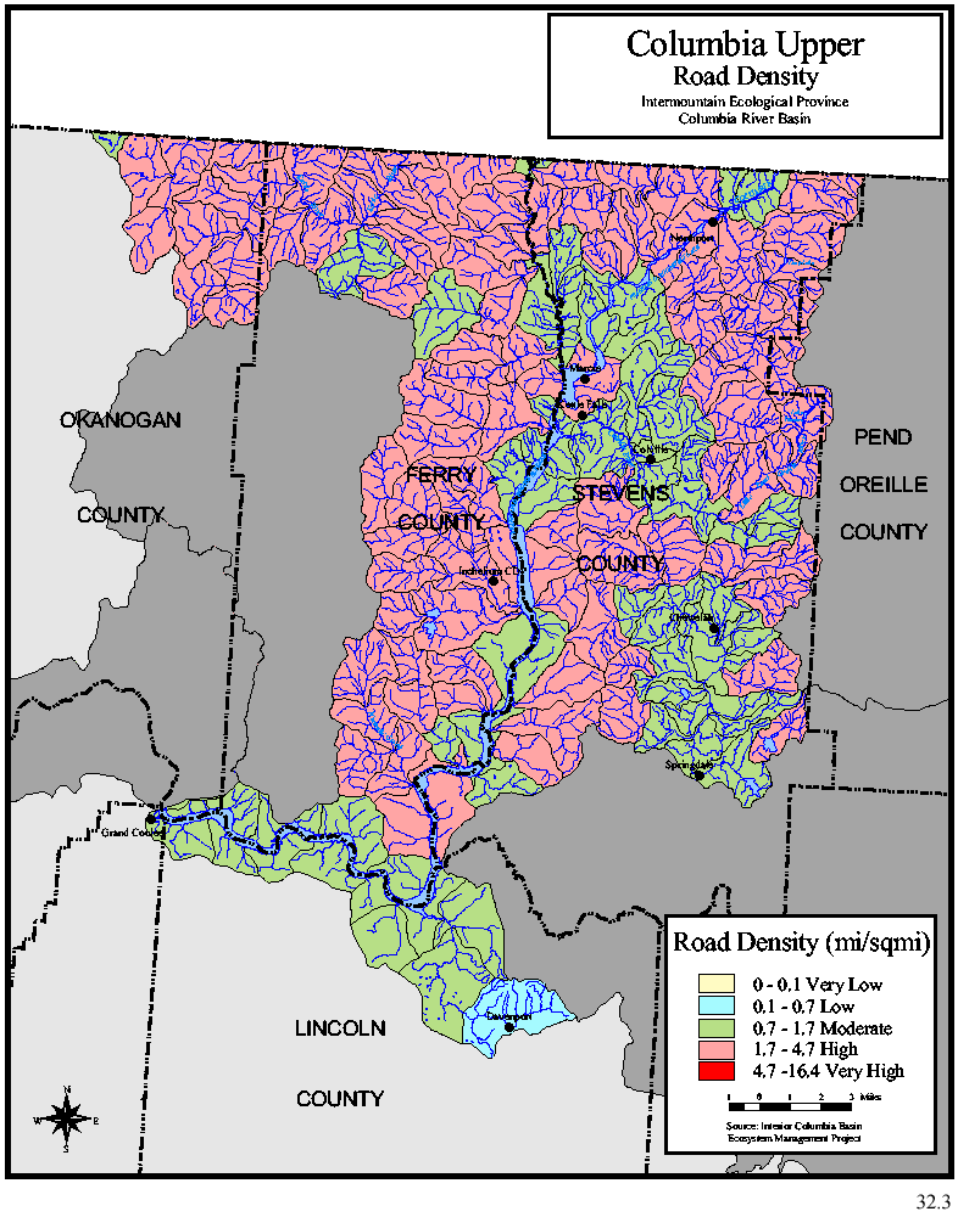

Figure 29.6. Road density by sixth order watersheds in the Upper Columbia Subbasin

29.3 Logic Path

The logic path starts with an overall physical description of the Subbasin, followed by an assessment of aquatic and terrestrial resources from which a management plan was created with specific strategies and objectives to address limiting factors and management goals. In the next section, Section 30: Aquatic Assessment Upper Columbia Subbasin, aquatic resources regarding the historic and current status of selected focal species are described in detail. An analysis based on the QHA technique (described in Section 3) identifies specific habitat attributes that have been altered the most over time relative to the entire Subbasin and which areas in the Subbasin are categorized as having poor or good habitat for the respective focal species. Based on the current status of the focal species, limiting habitat attributes, and management goals recognized in the Subbasin, strategies and objectives were identified and are presented in Section 34 Upper Columbia Subbasin Management Plan. The terrestrial assessment, provided in Section 32, provides a description of the historic and current status of wildlife species and condition of terrestrial habitat types within the Subbasin. Based on the terrestrial assessment and key findings, strategies and objectives were developed and are defined in Section 34: Upper Columbia Subbasin Management Plan.

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30 Upper Columbia Subbasin Assessment – Aquatic

30.1 Species Characterization and Status

Prior to hydroelectric development, species that historically ascended into the upper Columbia River included Chinook salmon *Oncorhynchus tshawytscha*, sockeye *O. nerka*, coho salmon *O. kisutch,* pink salmon *O. gorbuscha*, chum salmon *O. keta,* steelhead *O. mykiss* (Ray 1954)*,* and Pacific lamprey *Lampetra tridentatus.* Scholz et al. (1985) estimated total salmon and steelhead escapement above the current Grand Coulee Dam location was between 1.1 and 1.9 million fish annually, three times the average total return for the entire Columbia River Basin above Bonneville Dam (578,683) over the last 10 years (USACOE, Columbia River DART website).

Fish species known or presumed to be present within the Upper Columbia Subbasin are listed in Table 1. The fish community encompasses a variety of native and introduced species that may be encountered in various habitats within the Subbasin. All anadromous salmon and steelhead, as well as Pacific lamprey have been extirpated from the region. Species listed as native to Washington and had ranges that occurred within the Upper Columbia Subbasin, but have not been recorded as present are listed as "within range." The remaining native species that have been observed above Grand Coulee Dam are listed as "known."

Table 30.1. Fish species occurring within the Upper Columbia Subbasin

Species	Common Name	Origin	Status
Lampetra tridentata	Pacific lamprey	native	within range[5]- extirpated
Acipenser transmontanus	white sturgeon	native	known[1]
Coregonus clupeaformis	lake whitefish	introduced	known[2]
Prosopium williamsoni	mountain whitefish	native	known[2]
Oncorhynchus clarki	cutthroat trout	native	known[3]
Oncorhynchus mykiss	rainbow trout	native	known[2]
Oncorhynchus tshawytscha	Chinook salmon	native	known[4] - extirpated
Oncorhynchus gorbuscha	pink salmon	native	within range[5]- extirpated
Oncorhynchus kisutch	coho salmon	native	within range[5]- extirpated
Oncorhynchus keta	chum salmon	native	within range[5]- extirpated
Oncorhynchus nerka	sockeye salmon	native	known[4] - extirpated
Oncorhynchus nerka	kokanee salmon	native	known[2]
Salmo trutta	brown trout	introduced	known[2]
Salvelinus fontinalis	brook trout	introduced	known[2]
Salvelinus confluentus	bull trout	native	known[3]
Acrocheilus alutaceus	chiselmouth	native	known[2]
Couesius plumbeus	lake chub	native	within range[5]
Cyprinus carpio	common carp	introduced	known[2]
Mylocheilus caurinus	peamouth	native	known[2]
Ptychocheilus oregonensis	northern pikeminnow	native	known[2]
Rhinichthys cataractae	longnose dace	native	known[2]
Rhinichthys falcatus	leopard dace	native	within range[5]
Rhinichthys osculus	speckled dace	native	known[2]

Species	Common Name	Origin	Status
Richardsonius balteatus	redside shiner	native	known[2]
Tinca tinca	tench	introduced	known[2]
Catostomus catostomus	longnose sucker	native	known[2]
Catostomus columbianus	bridgelip sucker	native	known[2]
Catostomus macrocheilus	largescale sucker	native	known[2]
Catostomus platyrhynchus	mountain sucker	native	within range[5]
Ictalurus nebulosus	brown bullhead	introduced	known[6]
Percopsis transmontanus	sandroller	native	within range[5]
Lota lota	burbot	native	known[2]
Gasterosteus aculeatus	three-spine stickleback	native	within range[5]
Micropterus dolomieui	smallmouth bass	introduced	known[2]
Micropterus salmoides	largemouth bass	introduced	known[2]
Lepomis macrochirus	bluegill	introduced	known[6]
Lepomis gibbosus	pumpkinseed	introduced	known[6]
Pomoxis annularis	white crappie	introduced	known[2]
Pomoxis nigromaculatus	black crappie	introduced	known[2]
Perca flavescens	yellow perch	introduced	known[2]
Sander vitreus	walleye	introduced	known[2]
Cottus bairdi	mottled sculpin	native	known[2]
Cottus beldingi	piute sculpin	native	known[2]
Cottus cognatus	slimy sculpin	native	within range[5]
Cottus confusus	shorthead sculpin	native	within range[5]
Cottus rhotheus	torrent sculpin	native	within range[5]
Cottus asper	prickly sculpin	native	known[6]

[1]Anders and Powell 1999
[2]Griffith and McDowell 1996
[3]Tom Shuhda, Fish Biologist, USFS, personal communication
[4]Fish and Hanavan 1948
[5]Wydoski and Whitney 1979
[6]Washington Department of Fish and Wildlife Species Composition Data for Moses Lake, Washington

30.1.1 Lake Roosevelt

Based on 1997 to 1999 sampling (McLellan et al. 2003; Spotts et al. 2002; Cichosz et al. 1999), more than 25 fish species are known to occur throughout Lake Roosevelt. In 1999, rainbow trout and walleye comprised >99 percent of the harvested fish in the reservoir, while all other species combined to comprise <1 percent of the harvest (McLellan et al. 2003). In all, the Lake Roosevelt fishery accounts for 140,000 to 600,000 angler trips annually and has an annual economic worth of between $5 and $20 million (McLellan et al. 2003; Spotts et al. 2002; Cichosz et al. 1999; Underwood and Shields 1995).

Stomach content analysis of 16 different fish species residing in Lake Roosevelt were conducted by McLellan et al. (2003). Results indicated that eleven of the examined species had substantial diet overlap (>0.70) with at least one other species. Substantial diet overlap values were observed between the following species: eastern brook trout with kokanee salmon, brown trout, rainbow trout and smallmouth bass; rainbow trout with kokanee salmon and lake whitefish; tench with bridgelip sucker, longnose sucker

and northern pikeminnow; and largescale sucker with bridgelip sucker, longnose sucker, and lake whitefish. Black crappie, burbot, mountain whitefish, walleye, and yellow perch did not exhibit high diet overlap with any other species. Rainbow trout and kokanee salmon exhibited the highest dietary overlap among all species. Cladocera (34.63 percent) had the highest relative importance (Ri_a) among identified prey items across all fish species, followed by Osteichthyes (11.52 percent) and Diptera (9.89 percent). Across all species, Osteichthyes comprised the highest percent of the diet by dry weight (21.84 percent), followed by Cladocera (13.5 percent). Cladocera were consumed in the highest numbers, making up 96.0 percent of the total items consumed. Fish had the highest relative importance in the diets of both burbot and walleye, and were also important in the diets of rainbow trout, eastern brook trout, brown trout, northern pikeminnow, smallmouth bass, and yellow perch. Results suggested that zooplankton populations in Lake Roosevelt were substantially utilized by fishes as evidenced by relative importance of zooplankton in their diets (McLellan et al. 2003).

Despite the healthy zooplankton population, benthic macroinvertebrates in Lake Roosevelt are limited due to annual changes in lake elevation, minimal macrophyte production, and substrate types. As a result, the secondary trophic level of Lake Roosevelt consists mostly of zooplankton (Peone et al. 1989).

30.1.2 Kettle River

The salmonid fish assemblage in the Kettle River watershed mainly consists of native redband trout and mountain whitefish populations, as well as a nonnative brown trout population. See Section 30.4 for more detail about redband/rainbow trout.

30.1.3 Colville River

The sport fishery in the Colville River consists mainly of rainbow, brown trout, and brook trout; however, very little information is available (Curt Vail, Fish Biologist, WDFW, personal communication, 2003). Inventory projects in some of the tributaries reveal that native populations of westslope cutthroat trout are extremely limited and in many areas are not detectable. Substantial populations of introduced brook trout are present throughout the Colville River watershed and the Upper Columbia Subbasin.

30.1.4 Lakes

30.1.4.1 Curlew Lake

The sport fishery in Curlew Lake focused primarily on rainbow trout. Although largemouth bass are abundant, they provide a lesser fishery than trout. Historic reports indicate the presence of trout, grayling and other fish occupying Curlew Lake in the late nineteenth century (Juul 1989). In the early 1900s, bass and silver salmon (kokanee salmon) were reported to be very numerous. Kokanee spawning was last reported in the 1940s (Juul 1989), and today the lake is void of kokanee. Currently, the lake supports rainbow trout, largemouth bass, northern pike minnow, brook trout, chubs, suckers, and tiger muskellunge. The majority of the rainbow trout population is maintained with stocked hatchery and net pen reared fish and the tiger muskellunge population is supported through stocking of hatchery-reared fish. Although smaller in numbers than the stocked population, adfluvial redband/rainbow trout are present in Curlew Lake, which

migrate into Trout Creek to spawn (Curt Vail and Sandy Lembcke, WDFW, personal communication, 2003).

30.1.4.2 Other Lakes

Many lakes within the Subbasin are located on the Colville Reservation and are managed by the Colville Confederated Tribes (CCT). Reservation lakes provide recreational fishing opportunities for both Tribal and non-Tribal members. Twin Lakes, which includes North Twin and South Twin lakes, are considered to provide most important recreational fishery (brook and rainbow trout) for Tribal and non-Tribal members. Round Lake is also an important recreational fishery for brook and rainbow trout and is stocked annually. Sugar and Nichols lakes are stocked annually with rainbow trout and Simpson Lake is stocked with brook trout. Bourgeau Lake is stocked annually with rainbow trout and also contains a self-sustaining population of largemouth bass that is not managed. Elbow Lake is sometimes referred to as "ghost" lake and is only stocked with rainbow trout after two above average annual snow events occur. Elbow Lake drains into a small fracture and is dependent on high precipitation to support a recreational fishery.

Lakes outside the Colville Reservation are managed by the Washington Department of Fish and Wildlife (WDFW). Although numerous fishing opportunities exist, some of the more popular lakes are Long, Swan, and Ferry. Long Lake is managed as a fly-fishing only lake and provides a high quality cutthroat trout fishery. Swan Lake is stocked with catchable rainbow trout, which are the main target species for anglers. In addition, Ferry Lake is managed as a rainbow trout fishery.

30.2 Focal Species Selection

Focal species selected in the Upper Columbia Subbasin include white sturgeon, redband/rainbow trout, kokanee salmon, Chinook salmon, Pacific lamprey, and burbot. The rationale for these selections, the historic and current status of the species, and current management are presented in sections 30.3 to 30.8. Although westslope cutthroat trout are not listed as a focal species in the Upper Columbia Subbasin, and were not analyzed using the QHA model, they are native to portions of the Subbasin and still occur in limited geographic areas. Westslope cutthroat trout are an important species in the Upper Columbia Subbasin from a native salmonid restoration and preservation view.

30.3 Focal Species – White Sturgeon

The white sturgeon was selected as a focal species due to its ecological significance, cultural importance to the Upper Columbia United Tribes, and the species economic value.

White sturgeon are found in marine waters and freshwater rivers along the Pacific Coast from California to Alaska (Wydoski and Whitney 2003). In the State of Washington, white sturgeon are found in the Columbia and Snake rivers, Grays Harbor, Willapa Bay, Puget Sound, and Lake Washington (Wydoski and Whitney 2003).

White sturgeon are the largest fish found in the freshwaters of North America, with specimens being reported to reach length of 20 ft and weights of 1, 800 pounds (Wydoski

and Whitney 2003). Reproduction occurs at between 9 and 16 years of age and only a small percentage of adults may spawn in any given year. White sturgeon migrate great distances in unimpounded rivers and display both anadromous and resident life history forms.

White sturgeon in the Columbia River declined in numbers due numerous factors, including obstruction of migration by dams, altered stream flows, altered temperature regimes, reduced spawning habitats, and over-harvest (Wydoski and Whitney 2003).

30.3.1 Historic Status

Prior to hydroelectric development, white sturgeon within the Subbasin were likely to be exhibit both anadromous and resident life histories and may have migrated considerable distances between Subbasins within the Columbia River (Upper Columbia White Sturgeon Recovery Plan 2002). Recent genetic surveys indicate white sturgeon from Lake Roosevelt contain several diverse, maternal lineages. These results suggest pre-impoundment white sturgeon exhibited long migrations in the Columbia River (Anders 2002)

In general, white sturgeon are not known to display variable life history strategies other than occasional, facultative anadromy. Typical traits associated with benthic feeding white sturgeon include a long life span (>100 years), large size (682 kg is the largest on record), delayed maturation, spring spawning, and high fecundity (Upper Columbia White Sturgeon Recovery Plan 2002). However, survival from egg to adult is relatively low (Anders 2002).

White sturgeon have not historically been stocked within the Upper Columbia Subbasin.

30.3.2 Current Status

The current white sturgeon population estimate is 1,400 adults in the transboundary region of the Upper Columbia River basin (Upper Columbia White Sturgeon Recovery Plan 2002). Specific numbers for the Upper Columbia Subbasin are not known. Nonetheless, the population status is considerably less than the endangered status criteria of 2,500 adults determined by the World Conservation Union (Upper Columbia White Sturgeon Recovery Plan 2002). Although most of the upper-mainstem populations appear unstable, their genetic similarity to the stable lower Columbia River population has excluded them from consideration for listing under the federal Endangered Species Act, unlike the Kootenai River population.

White sturgeon are found in Lake Roosevelt and the Columbia River upstream of the reservoir. Any anadromous component to the life history of white sturgeon within the Subbasin has been lost. Genetic diversity of the samples collected is similar to the diversity observed elsewhere within the Columbia and Kootenai basins (Upper Columbia White Sturgeon Recovery Plan 2002).

In 1998, a stock-indexing project (Devore et al. 2000) found that only 1.5 percent of the captured white sturgeon were juveniles (<110 cm Fork Length), suggesting poor

recruitment. Furthermore, of the 204 fish captured, only three were captured in experimental gill nets (deployed for the purpose of catching juvenile sturgeon) and length at age assignments revealed an age structure of 12- to 96-year-old fish (Devore et al. 2000), indicating that older fish dominate the population structure. The conclusion that there are severe recruitment limitations (Devore et al. 2000) supports conclusions of research conducted in the Canadian Reach of the Columbia River (R.L. & L. Environmental Services Ltd. 1996). In addition, Devore et al. (2000) found that the relative weight (Wr) of 91 percent of the white sturgeon collected from Lake Roosevelt was lower than other populations. To date, this is the lowest recorded Wr value recorded for any Columbia River Basin white sturgeon population. If this trend in poor recruitment and condition of white sturgeon continues, the population in Lake Roosevelt may be in jeopardy. If recruitment does not improve, the Upper Columbia River basin population is projected to decline 50 percent within 10 years and 75 percent within 20 years (Upper Columbia White Sturgeon Recovery Plan 2002).

Distribution of white sturgeon within the Upper Columbia Subbasin is dependent upon water condition and suitable habitat (Devore et al. 2000). Trends in abundance will likely show declines since there appear to be little or no juvenile recruitment within the stock (Anders, 2002; Devore et al. 2000). Carrying capacity within the Upper Columbia Subbasin is not known and needs to be further assessed. Current stocks are considered depressed but limiting factors are not completely known. Areas of successful spawning and recruitment are habitats to be identified, protected, and/or enhanced.

30.3.3 Current Management

In 2002, a recovery plan for the Upper Columbia white sturgeon was designed by a cooperative effort among Canadian and U.S. Federal, Provincial, State, First Nation and Tribal agencies. The basic components of the plan include short-, medium-, and long-term objectives. Assessment of the population status is the primary short-term objective. Determination of the limiting factors and feasible response measures are the medium-term objectives. Long-term objectives include re-establishing a self-sustaining population by increasing recruitment, re-establishing a natural age structure in the population, and meeting target abundance levels. If these objectives are met, and a healthy white sturgeon population is re-established, beneficial uses of white sturgeon would likely increase within the area (Upper Columbia White Sturgeon Recovery Plan 2002).

Harvest of white sturgeon is closed in all portions of the Columbia River upstream of Chief Joseph Dam (WDFW 2003). White sturgeon are not stocked nor do any captive breeding programs currently exist within Washington, however Canada has a conservation production facility for Upper Columbia River white sturgeon. These fish have been found to migrate into Lake Roosevelt (2002 Lake Roosevelt Sturgeon Recovery Project Report).

During February 2003, two thousand eight month-old juvenile white sturgeon were transported from the Kootenay Sturgeon Conservation Hatchery near Cranbrook, B.C. to the WDFW Columbia Basin Fish Hatchery at Moses Lake. The transplants are part of the Upper Columbia white sturgeon recovery plan and will be used to supplement the white

sturgeon population in the Columbia River near the U.S.-Canadian border. Each young fish will be implanted with a small PIT (passive integrated transponder) tag, which will provide information on the background of individual fish for monitoring purposes. The juvenile white sturgeons will be released when they are one year in age.

Washington Department of Fish and Wildlife's Columbia Basin hatchery has the water-heating capability needed for the warmer water temperatures that sturgeon require. Improvements to the Colville fish hatchery will be an interim measure while the Canada-U.S. recovery team completes a feasibility study to determine the potential for a U.S. sturgeon broodstock holding facility and rearing hatchery dedicated for sturgeon aquaculture.

In 2002 and 2003, a combined total of nearly 20,000 juvenile sturgeon were released into the Columbia River north of the Canadian border. In addition, in May of 2004, 2,000 juvenile sturgeon from British Columbia and reared at WDFW's Columbia Basin Hatchery were pit tagged and released into Lake Roosevelt. In the years ahead, the U.S. and Canada will together release up to 12,000 juvenile sturgeon in the U.S. and Canadian portions of the Columbia River.

30.4 Focal Species – Redband/Rainbow Trout

Redband/rainbow trout were selected as a focal species due to their recreational importance as a sport fish, their subsistence value to Upper Columbia United Tribes, and their ecological significance within the watershed. Rainbow trout are stocked into Lake Roosevelt annually through a resident fish hatchery program established as partial-mitigation for losses of anadromous salmon and steelhead in the blocked area above Grand Coulee Dam.

Rainbow trout were historically distributed from northern Mexico to southeastern Alaska and inland in rivers that are free of natural obstructions from the Pacific Ocean (Behnke 1992). Rainbow trout exhibit both anadromous and non-anadromous life history strategies, with the anadromous form being referred to as steelhead. Three life history strategies are displayed by non-anadromous rainbow trout. Fluvial fish rear as adults in larger rivers and migrate to tributary streams to spawn, adfluvial fish rear as adults in lakes or reservoirs and migrate to tributaries to spawn, and resident fish spend their entire life cycle in tributary streams. The present distribution of rainbow trout and steelhead has been affected by both indiscriminate stocking practices and habitat alterations (Wydoski and Whitney 2003).

Rainbow trout are a cold-water salmonid that prefer water with temperatures below 70^{o} F and high amounts of dissolved oxygen (Wydoski and Whitney 2003). Rainbow trout typically mature between age 1 and age 5, depending on their growth rates (Wydoski and Whitney 2003). Rainbow trout spawn in the spring usually between February and June, depending on the temperature and location. Substrate composition, cover, water quality, and water quantity are important habitat elements for spawning rainbow trout (Bjornn and Reiser 1991). Juvenile rainbow trout typically prey on drifting organisms while residing in lotic systems and prey on a variety of planktonic, terrestrial, and bethic

organisms when in lentic habitats. Adult rainbow trout are ominivorous and often feed on the most abundant prey resource at any given time. As rainbow trout grow in size, a proportion of their diet may be comprised of fish.

Rainbow trout have been transplanted to many temperate-zone waters in both the northern and southern hemispheres and have self-sustaining populations in many areas (Bjornn and Reiser 1991). Two subspecies of rainbow trout exist in the State of Washington, the coastal rainbow trout (*O. mykiss mykiss*) and the redband trout (*O. mykiss gairdneri*). Redband rainbow trout are native to the IMP and currently at risk in many areas due to introgression from transplanted coastal rainbow trout stocks. The extirpated steelhead runs within the IMP were of the redband subspecies (Behnke 1992), therefore conservation of current redband populations may have benefits for recovering steelhead runs within the IMP in the future with the possibility of fish passage at Chief Joseph and Grand Coulee dams.

30.4.1 Historic Status

The species *Oncorhynchus mykiss* was divided into two subspecies, *Oncorhynchus mykiss irideus* (rainbow trout) and *Oncorhynchus mykiss gairdneri* (redband trout) within the early twentieth century (Behnke 2002). Though these common names are often used interchangeably, only *O. m. gairdneri* were present in the Upper Columbia Subbasin historically (Behnke 1992; 2002). This subspecies exhibited three differing life history strategies including an anadromous form referred to as steelhead, a small-sized, stream resident form (fluvial) most often referred to as redband or redside trout and a large, lake adapted form. All steelhead within the IMP were summer-run fish that entered the system mainly from May through September. Historical accounts indicate as many as one million steelhead adults entered the Columbia River under optimal conditions before impacted by European settlement.

Development of the FCRPS adversely impacted the ability of native fluvial rainbow trout to sustain a viable population with a harvestable surplus. After the construction of Grand Coulee Dam stocking of hatchery-reared rainbow trout (*O. m. irideus*) into the Upper Columbia Subbasin commenced.

30.4.2 Current Status

Currently there are three life history strategies being expressed by redband trout in the Upper Columbia Subbasin, adfluvial, fluvial, and resident. It is believed that the adfluvial/fluvial forms of redband trout in this region have genetic material from remnant anadromous steelhead. The significance of maintaining these populations, aside from native species conservation is that these stocks may serve as native donor stocks for anadromous reintroduction.

Rainbow trout comprise an important part of the recreational fishery in Lake Roosevelt (Table 30.2). The rainbow trout population within Lake Roosevelt is generally strong with a significant amount of stocking from hatchery sources used to augment the fishery. In 1986, the Lake Roosevelt Development Association (LRDA) began a rainbow trout net pen program to supplement the rainbow trout fishery in Lake Roosevelt. Rainbow

trout reared in WDFW hatcheries have been stocked every year since 1990 at an average of over 188,373 annually. In addition, during 1999 the Colville Tribes Emergency Fish Relocation Program planted over 100,000 triploid steelhead into Lake Roosevelt. The planting supported a winter fishery in the Kettle Falls area and these fish continue to contribute to the Lake Roosevelt fishery (Monte Miller, Fish Biologist, CCT, personal communication, 2004). Although wild rainbow are present in Lake Roosevelt, they comprise little of the total harvest.

Native redband trout dominate the fish community in the Kettle River watershed, but investigations in the early 1990s suggested a declining population of native redband trout throughout the system (Curt Vail, Fish Biologist, WDFW, personal communication, 2003). However, the population seems to be rebounding with current management strategies and as additional populations have been discovered in tributaries to the Kettle River.

As previously mentioned, rainbow trout are part of the sport fishery in the Colville River; however, little information is available of the current status of the population, but numbers are believed to be low (Curt Vail, Fish Biologist, WDFW, personal communication, 2003). Additional naturally self-sustaining populations of redband trout have been documented in Barnaby Creek on National Forest Lands and in Meadow, Jack and Bridge creeks on the Colville Indian Reservation.

Table 30.2. Summary of the economic value of the fishery, number of angler trips, number of fish caught, number of fish harvested and mean lengths of rainbow trout observed during creel surveys on Lake Roosevelt, WA (1990-1999)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Economic Value (millions)	$5.3	$12.8	$9.7	$20.7	$19.1	$8.7	$6.9	$5.8	$8.0
Angler Trips	171,725	398,408	291,380	594,508	469,998	232,202	176,769	146,264	196,775
No. Caught									
Rainbow trout	81,560	81,529	167,156	402,277	499,460	125,958	76,915	5,356	233,036
No. Harvested									
Rainbow trout	79,683	73,777	140,609	398,943	499,293	122,939	76,782	5,356	226,809
CPUE (per hr)									
Rainbow trout	0.13	0.20	0.22	0.17	0.21	0.08	0.10	0.01	0.18
HPUE (per hr)									
Rainbow trout	0.12	0.20	0.18	0.16	0.21	0.08	0.10	0.01	0.18
Mean Length (mm)									
Rainbow trout	346	348	422	471	473	410	363	395	364

30.4.3 Limiting Factors Redband/Rainbow Trout

Adfluvial and resident redband/rainbow trout were analyzed separately in the QHA due to their differing migratory life history strategies. Adfluvial redband/rainbow trout unlike resident redband/rainbow trout do not have access to all habitats. To examine all habitats for rainbow trout, resident life history strategies could be used, but the connectivity needed for adfluvial life histories would be lost in the assessment. In addition, differences in rearing location and behavior can be profound between these two life history forms. Therefore, it was important to assess habitat conditions for both life history types even if considerable overlap existed. The primary difference within the QHA assessment was not the physical habitat, but the habitat utilization hypothesis.

30.4.3.1 Resident Redband/Rainbow Trout

Historically, resident redband/rainbow trout were present in 72 of the 98 delineated reaches and watersheds in the Upper Columbia Subbasin. Cottonwood Creek (divided into two reaches) was included in the historic distribution, however resident redband/rainbow trout are no longer present there. Currently, resident redband/rainbow trout are distributed in 74 areas. Resident redband/rainbow trout have expanded into areas where they were not historically present, such as Upper Lynx and Deep creeks and the Lower Colville River. Genetically pure redband (resident redband/rainbow trout) populations within the Subbasin are listed in Table 30.3

Table 30.3. List of the twelve creeks on NFS lands and the Colville Reservation that support genetically pure redband populations

Creek Name
Nancy Creek
Barnaby Creek
Hall Creek
Deadman Creek
Lane and Canyon Creeks (tributaries to Sherman Creek)
Tonata Creek
Lone Ranch Creek
Trout Creek (tributary to Curlew Lake)
South Fork Chewelah Creek
Strauss Creek (a tributary of Mill Creek)
Lynx Creek

(*Source*: T. Shuhda and J. Arterburn personal communication, 2003)

The top five ranked reaches presented in Table 30.4 appear to have undergone severe habitat alterations compared to reference conditions negatively impacting riparian condition, habitat diversity, channel stability, and low flow regime. The most impacted streams appear to be Mill and lower Cottonwood creeks. Geographically the most altered habitats cover a variety of regions in the Subbasin including the northwestern corner

(Toroda, Myers, Mary Anne creeks), western section (Mill, Cottonwood creeks), and the reservoir to name a few (Table 30.4).

In general, the habitat attributes in the reaches and watersheds in the northern portion of the Subbasin are most similar to reference conditions and ranked highest for protection (Table 30.5). Some of these creeks include Boulder, Lone Ranch, Sheep, Deep, Nancy, and Deer creeks.

The tornado diagram (Table 30.6) and maps (Map UC-1, Map UC-2, located at the end of Section 30) represent the reach scores for both current habitat condition (ranging from zero to positive one, Map UC-1) and protection (ranging from zero to negative one, Map UC-2). Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

Table 30.4. Ranking of reaches with the largest deviation from the reference habitat conditions for resident redband/rainbow trout in the Upper Columbia Subbasin. A reach rank equal to 1 has the greatest deviation from reference condition in comparison to other reaches. Reach scores range from 0 to 1, with 1 having the greatest deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute having the greatest deviation from reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes equally deviate the most from the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
97	Toroda	1	0.7	1	1	1	7	11	1	1	8	8	10	6
96	Myers/Mary Anne	2	0.7	1	1	1	9	11	1	1	1	1	10	1
16	Mill/N Mill Ck	3	0.5	1	4	1	4	9	1	4	10	4	4	10
36	Middle Sherman Ck	4	0.4	1	1	3	3	7	3	10	10	3	9	7
1	Lower Cottonwood Ck	5	0.4	1	2	2	2	9	2	8	10	2	2	10
17	Middle and South Forks Mill Ck	6	0.4	3	3	1	2	9	7	3	10	7	3	10
75	Middle Hall Creek (Meadow)	7	0.3	2	3	6	5	9	8	10	7	4	10	1
90	Barnaby Creek to Colville River	8	0.3	7	2	1	2	8	8	2	8	6	2	8
91	Colville River To Kettle Falls	8	0.3	7	2	1	2	8	8	2	8	6	2	8
93	Ryan Narrows To Onion Creek	8	0.3	7	2	1	2	8	8	2	8	6	2	8
94	Onion Creek To Big Sheep Creek	8	0.3	7	2	1	2	8	8	2	8	6	2	8
95	Big Sheep Creek To Canada	8	0.3	7	2	1	2	8	8	2	8	6	2	8
9	Lower North Fork/S Fork Chewelah	13	0.3	1	1	1	1	9	7	7	11	9	6	1
14	Huckleberry Range	14	0.3	2	2	2	2	8	1	9	9	7	6	9

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
49	Grand Coulee Dam To San Poil Arm	14	0.3	7	2	1	2	8	8	2	8	5	6	8
50	San Poil Arm To Hawk Creek	14	0.3	7	2	1	2	8	8	2	8	5	6	8
51	Hawk Creek to Spokane Arm	14	0.3	7	2	1	2	8	8	2	8	5	6	8
52	Spokane Arm to Ninemile Creek	14	0.3	7	2	1	2	8	8	2	8	5	6	8
58	Ninemile Creek To Hunter Creek	14	0.3	7	2	1	2	8	8	2	8	5	6	8
64	Hunters Creek To Gifford's Landing	14	0.3	7	2	1	2	8	8	2	8	5	6	8
85	Gifford's Landing to Barnaby Creek	14	0.3	7	2	1	2	8	8	2	8	5	6	8
98	Hawk Creek	22	0.3	1	1	1	6	8	7	8	10	5	1	10
34	Deadman Ck	23	0.3	2	4	4	3	9	10	4	10	4	8	1
53	Lower Ninemile Creek (Lake to Falls)	23	0.3	3	5	1	4	10	7	9	6	7	11	1
12	LPO River	25	0.3	1	1	1	1	7	1	8	8	6	8	8
92	Kettle Falls To Ryan Narrows	25	0.3	7	2	1	2	8	8	2	8	6	2	11
2	Upper Cottonwood Ck	27	0.3	1	5	1	3	9	5	5	10	5	3	10
81	Sitdown Creek	28	0.3	3	2	3	3	8	6	11	6	9	10	1
67	Upper Stranger Creek	29	0.2	4	2	3	6	8	4	9	9	7	9	1
76	Onion Creek (No. Fork Hall Creek)	29	0.2	4	6	2	1	8	6	9	11	4	10	2
29	Lower Pierre Ck/TouLou Ck	31	0.2	1	5	1	4	8	1	9	9	5	7	9
55	Ninemile Creek 3 (Meadow reach)	32	0.2	2	2	5	4	10	7	8	8	5	11	1
46	Tonata Ck	33	0.2	1	4	4	2	9	4	4	9	4	2	9

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
72	Granite Creek	34	0.2	2	4	6	3	8	6	10	9	5	10	1
47	Upper Kettle River	35	0.2	2	3	1	6	8	3	8	8	3	6	8
59	Lower Wilmont Creek (Lake To falls)	36	0.2	3	9	2	5	8	4	10	7	6	10	1
65	Lower Stranger Creek (To Cornstalk)	37	0.2	2	1	3	4	8	7	10	9	6	10	4
62	Nez Perce Creek	38	0.2	2	6	2	5	8	6	9	11	2	9	1
74	Lower Hall Creek (Canyon)	39	0.2	3	7	3	2	8	6	10	9	1	10	3
10	Bayley Ck/Upper N Fk Chewelah	40	0.2	2	2	2	1	8	2	2	10	8	7	10
87	Lower Barnaby Creek (Reservation)	41	0.2	2	2	4	5	11	6	9	6	6	9	1
37	Upper Cherman Ck	42	0.2	1	3	3	2	7	8	8	8	3	6	8
38	S Fk Sherman Ck	42	0.2	1	3	3	1	6	7	7	7	3	7	7
73	Beaver Dam Creek	44	0.2	2	2	2	5	7	8	9	11	6	9	1
78	Middle Lynx Creek (Confined/Falls)	45	0.2	2	5	2	7	6	4	9	11	8	9	1
42	N and S Fks St Peters Ck	46	0.2	1	3	3	2	7	7	7	7	3	6	7
60	Middle Wilmont Creek (Unconfined)	47	0.1	3	3	3	1	7	2	8	8	6	8	8
68	Lower Cornstalk Creek	48	0.1	3	6	3	6	6	6	6	2	5	6	1
33	Boulder Ck	49	0.1	1	3	3	2	8	9	3	9	3	7	11
61	Upper Wilmont Creek (Higher Gradient)	50	0.1	2	5	5	2	7	4	10	8	8	10	1
57	Upper Ninemile Creek	51	0.1	4	7	4	2	9	7	10	6	3	11	1
35	Lower Sherman Ck	52	0.1	6	6	6	1	5	2	6	6	2	4	6

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
82	Stall Creek	53	0.1	4	6	3	2	9	6	10	5	8	10	1
22	Onion Ck	54	0.1	1	4	1	3	7	4	8	8	4	8	11
88	Upper Barnaby Creek (State)	55	0.1	1	2	4	3	7	5	9	7	5	9	9
77	Lower Lynx Creek (Unconfined)	56	0.1	4	1	1	6	7	1	8	4	8	8	8
26	Lower Deep Ck	57	0.1	1	4	1	3	4	4	4	4	4	4	4
56	South Fork Ninemile Creek	58	0.1	5	5	7	2	7	3	10	7	3	11	1
32	E Deer Ck	59	0.1	3	3	3	2	3	3	3	3	3	3	1
39	Nancy Ck	60	0.1	1	4	2	3	4	4	4	4	4	4	4
44	Long Alec/W Deer Cks	61	0.1	2	4	2	1	4	4	4	4	4	4	4
54	Ninemile Creek 2 (Confined reach)	62	0.1	1	2	2	2	8	5	7	9	5	10	11
84	North Fork Hall Creek	63	0.1	2	5	6	4	6	2	9	8	9	9	1
23	Lower Sheep Ck	64	0.1	4	4	1	3	4	4	4	4	1	4	4
24	Middle Sheep CK	64	0.1	1	4	1	3	4	4	4	4	4	4	4
25	Upper Sheep Ck	64	0.1	1	4	1	3	4	4	4	4	4	4	4
27	Middle Deep Creek	64	0.1	4	4	1	3	4	4	4	4	1	4	4
28	Upper Deep Ck	64	0.1	4	4	1	3	4	4	4	4	1	4	4
45	Lone Ranch Ck	69	0.0	3	4	1	2	4	4	4	4	4	4	4
80	Upper Hall Creek	70	0.0	2	7	4	6	3	8	10	9	4	10	1
83	West Fork Hall Creek	71	0.0	2	2	6	4	6	5	6	6	6	11	1

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
31	Little Boulder Ck	72	0.0	2	2	2	1	2	2	2	2	2	2	2

Table 30.5. Ranking of streams whose habitat is most similar to the reference condition for resident redband/rainbow trout in the Upper Columbia Subbasin in comparison to other reaches. A reach rank equal to 1 reveals the reach with current conditions most similar to reference conditions in comparison to other reaches. Reach score ranges from 0 to -1, with -1 having the least deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute being most similar to the reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes are equally the most similar to the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
31	Little Boulder Ck	1	-0.88	1	1	1	10	10	1	1	1	1	9	1
45	Lone Ranch Ck	2	-0.84	7	1	8	10	10	1	1	1	1	9	1
23	Lower Sheep Ck	3	-0.83	1	1	7	10	10	1	1	1	7	9	1
27	Middle Deep Creek	3	-0.83	7	1	7	10	10	1	1	1	1	9	1
28	Upper Deep Ck	3	-0.83	7	1	7	10	10	1	1	1	1	9	1
39	Nancy Ck	6	-0.82	10	1	7	9	10	1	1	1	1	8	1
44	Long Alec/W Deer Cks	6	-0.82	7	1	7	11	10	1	1	1	1	9	1
32	E Deer Ck	8	-0.81	1	1	1	9	9	1	1	1	1	8	11
26	Lower Deep Ck	9	-0.80	8	1	8	11	10	1	1	1	1	7	1
24	Middle Sheep CK	10	-0.74	1	1	6	9	9	1	1	1	6	8	11
25	Upper Sheep Ck	10	-0.74	1	1	6	9	9	1	1	1	6	8	11
42	N and S Fks St Peters Ck	12	-0.73	8	5	5	11	8	1	1	1	5	8	1
18	Rocky/MDW Cks	13	-0.72	4	4	4	11	10	4	4	1	1	9	1
37	Upper Cherman Ck	13	-0.72	8	5	5	11	10	1	1	1	5	8	1
38	S Fk Sherman Ck	13	-0.72	9	5	5	11	10	1	1	1	5	8	1

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
10	Bayley Ck/Upper N Fk Chewelah	**16**	-0.71	4	4	4	11	10	4	4	1	3	9	1
83	West Fork Hall Creek	**17**	-0.71	3	3	8	7	8	11	1	8	1	6	5
33	Boulder Ck	**18**	-0.70	8	4	4	11	10	1	4	1	4	8	1
22	Onion Ck	**19**	-0.69	8	4	8	11	10	4	1	1	4	7	1
35	Lower Sherman Ck	**20**	-0.69	1	1	1	10	9	6	1	1	6	8	11
46	Tonata Ck	**21**	-0.67	8	3	3	10	8	3	3	1	3	10	1
87	Lower Barnaby Creek (Reservation)	**22**	-0.66	4	4	3	9	10	6	1	6	2	8	11
47	Upper Kettle River	**23**	-0.66	7	4	11	9	7	4	1	1	4	9	1
29	Lower Pierre Ck/TouLou Ck	**24**	-0.66	6	4	6	11	10	6	1	1	4	6	1
54	Ninemile Creek 2 (Confined reach)	**25**	-0.65	7	4	4	10	9	7	1	2	2	6	10
78	Middle Lynx Creek (Confined/Falls)	**26**	-0.64	4	3	4	8	9	10	1	7	2	6	11
12	LPO River	**27**	-0.63	6	6	6	11	10	6	1	1	4	5	1
73	Beaver Dam Creek	**28**	-0.62	4	4	8	7	10	9	1	2	2	6	11
34	Deadman Ck	**29**	-0.61	7	3	3	10	9	1	3	1	3	7	11
79	Upper Lynx Creek	**30**	-0.60	2	3	8	6	10	9	1	6	4	5	11
59	Lower Wilmont Creek (Lake To falls)	**31**	-0.60	10	2	6	6	9	8	1	4	3	5	10
77	Lower Lynx Creek (Unconfined)	**32**	-0.59	5	3	7	6	10	11	1	9	1	4	7
62	Nez Perce Creek	**33**	-0.59	3	2	7	7	10	7	1	6	3	5	11
14	Huckleberry Range	**34**	-0.58	5	5	5	11	8	10	1	1	4	9	1
72	Granite Creek	**35**	-0.57	7	3	6	11	9	7	1	4	2	5	10

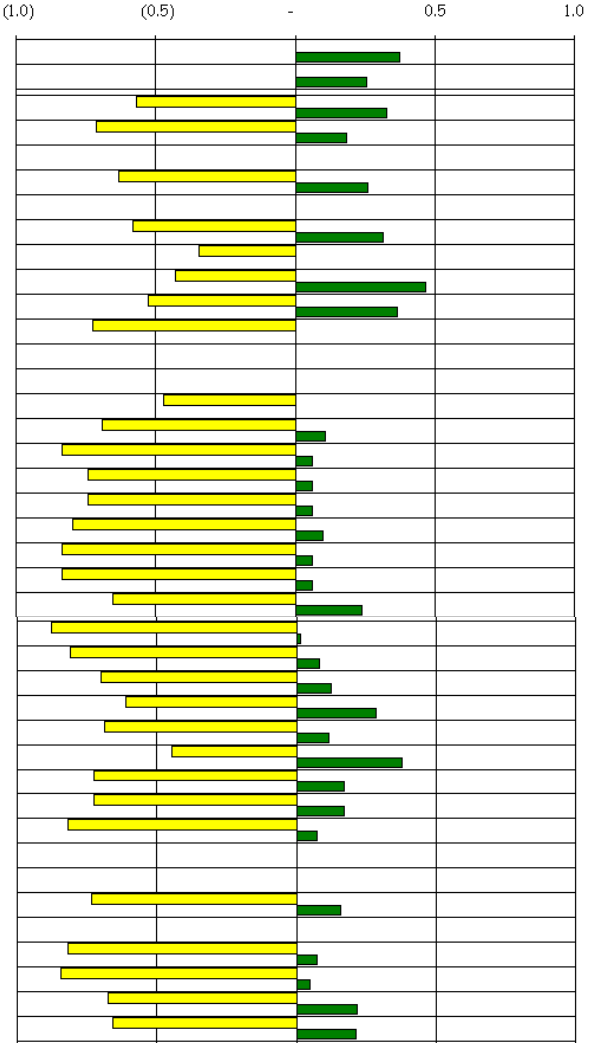
Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
9	Lower North Fork/S Fork Chewelah	36	-0.57	5	5	5	11	9	3	3	1	2	10	5
49	Grand Coulee Dam To San Poil Arm	36	-0.57	4	6	11	10	6	1	6	1	5	9	1
50	San Poil Arm To Hawk Creek	36	-0.57	4	6	11	10	6	1	6	1	5	9	1
51	Hawk Creek to Spokane Arm	36	-0.57	4	6	11	10	6	1	6	1	5	9	1
52	Spokane Arm to Ninemile Creek	36	-0.57	4	6	11	10	6	1	6	1	5	9	1
58	Ninemile Creek To Hunter Creek	36	-0.57	4	6	11	10	6	1	6	1	5	9	1
64	Hunters Creek To Gifford's Landing	36	-0.57	4	6	11	10	6	1	6	1	5	9	1
85	Gifford's Landing to Barnaby Creek	36	-0.57	4	6	11	10	6	1	6	1	5	9	1
88	Upper Barnaby Creek (State)	44	-0.57	7	3	5	10	9	6	1	8	2	4	11
94	Onion Creek To Big Sheep Creek	45	-0.56	4	6	11	9	6	1	6	1	5	9	1
95	Big Sheep Creek To Canada	45	-0.56	4	6	11	9	6	1	6	1	5	9	1
67	Upper Stranger Creek	47	-0.56	3	7	5	8	9	10	1	3	2	6	11
90	Baraby Creek to Colville River	48	-0.56	4	6	11	9	6	1	6	1	5	9	1
91	Colville River To Kettle Falls	48	-0.56	4	6	11	9	6	1	6	1	5	9	1
92	Kettle Falls To Ryan Narrows	48	-0.56	4	6	11	9	6	1	6	1	5	9	1
93	Ryan Narrows To Onion Creek	48	-0.56	4	6	11	9	6	1	6	1	5	9	1
60	Middle Wilmont Creek (Unconfined)	52	-0.55	3	3	7	10	9	8	1	3	2	6	11
55	Ninemile Creek 3 (Meadow reach)	53	-0.55	9	6	6	11	8	5	1	2	2	4	10
81	Sitdown Creek	54	-0.54	7	4	3	10	9	5	1	5	2	8	11
74	Lower Hall Creek (Canyon)	55	-0.53	9	3	5	10	8	4	1	2	5	5	11

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
17	Middle and South Forks Mill Ck	56	-0.53	5	5	9	11	8	3	5	1	3	10	1
98	Hawk Creek	57	-0.51	5	5	5	9	8	3	2	1	4	10	11
75	Middle Hall Creek (Meadow)	58	-0.50	9	6	6	10	8	3	1	2	5	4	11
53	Lower Ninemile Creek (Lake to Falls)	59	-0.49	9	4	9	8	7	5	1	3	2	6	9
76	Onion Creek (No. Fork Hall Creek)	60	-0.48	6	2	9	10	8	6	1	2	5	4	10
21	Deep Ck	61	-0.47	8	4	4	10	7	4	2	1	2	10	8
36	Middle Sherman Ck	62	-0.45	7	7	3	10	7	3	1	1	3	3	11
16	Mill/N Mill Ck	63	-0.43	6	3	6	9	11	6	3	1	3	9	1
15	Lower Colville River	64	-0.34	9	5	9	9	8	5	3	1	3	7	1
80	Upper Hall Creek	65	-0.33	9	4	10	3	6	7	1	11	5	1	8
84	North Fork Hall Creek	65	-0.33	7	6	9	3	8	10	1	11	4	1	4
68	Lower Cornstalk Creek	67	-0.32	6	6	6	3	9	10	1	11	5	1	4
56	South Fork Ninemile Creek	68	-0.30	9	5	6	3	6	10	1	10	6	1	4
61	Upper Wilmont Creek (Higher Gradient)	69	-0.30	8	5	5	3	7	9	1	9	4	1	11
82	Stall Creek	70	-0.28	5	7	9	3	6	9	1	11	4	1	8
57	Upper Ninemile Creek	71	-0.26	4	3	4	8	6	9	1	10	6	1	11
65	Lower Stranger Creek (To Cornstalk)	72	-0.26	8	10	6	4	4	7	1	9	3	1	11
96	Myers/Mary Anne	73	-0.22	1	1	1	11	1	1	1	1	1	10	1
97	Toroda	74	-0.17	6	6	6	6	4	6	6	1	1	3	4

Table 30.6. Tornado diagram for resident redband/rainbow trout Upper Columbia Subbasin. Degree of confidence for protection and current habitat conditions range from 0.0 to 1.0 with the greatest confidence equal to 1.0. Protection reach scores are presented on the left side and current habitat reach scores are presented on the right. Negative scores are in parentheses.

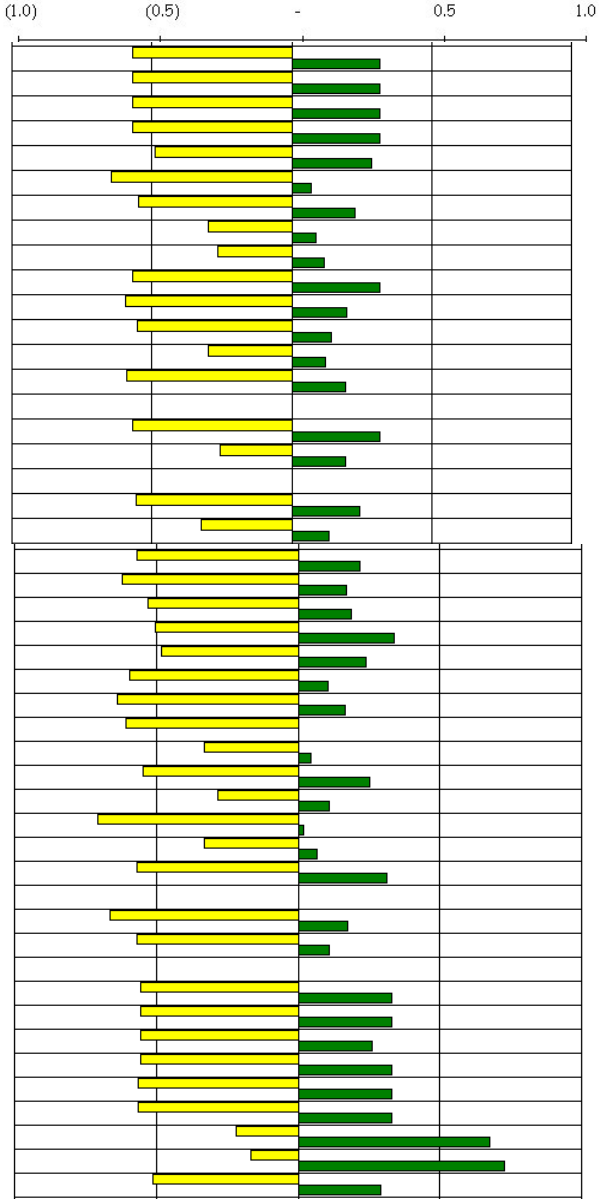
NP = Not present

Sequence	Reach Name	Protection Confidence	Current Habitat Condition Confidence
1	Lower Cottonwood Ck	0.33	0.25
2	Upper Cottonwood Ck	0.33	0.25
9	Lower North Fork/S Fork Chewelah	0.33	0.25
10	Bayley Ck/Upper N Fk Chewelah	0.33	0.25
11	LPO Lakes	NP	
12	LPO River	0.33	0.25
13	Addy/Indian/Morahan/12 Mile Ck	NP	
14	Huckleberry Range	0.33	0.25
15	Lower Colville River	NP	
16	Mill/N Mill Ck	0.33	0.25
17	Middle and South Forks Mill Ck	0.50	0.33
18	Rocky/MDW Cks	NP	
19	Smackout Ck	NP	
20	Deep Lake	NP	
21	Deep Ck	NP	
22	Onion Ck	0.33	0.25
23	Lower Sheep Ck	0.33	0.25
24	Middle Sheep CK	0.33	0.25
25	Upper Sheep Ck	0.50	0.33
26	Lower Deep Ck	0.50	0.33
27	Middle Deep Creek	0.50	0.33
28	Upper Deep Ck	0.50	0.33
29	Lower Pierre Ck/TouLou Ck	0.33	0.25
31	Little Boulder Ck	0.50	0.33
32	E Deer Ck	0.50	0.33
33	Boulder Ck	0.50	0.33
34	Deadman Ck	0.50	0.33
35	Lower Sherman Ck	0.33	0.25
36	Middle Sherman Ck	0.50	0.33
37	Upper Cherman Ck	0.50	0.33
38	S Fk Sherman Ck	0.50	0.33
39	Nancy Ck	0.50	0.33
40	Roper/LaFleur/Mantin cks	NP	
41	Lower Kettle River	NP	
42	N and S Fks St Peters Ck	0.50	0.33
43	Upper Curlew Ck	NP	
44	Long Alec/W Deer Cks	0.50	0.33
45	Lone Ranch Ck	0.50	0.33
46	Tonata Ck	0.50	0.33
47	Upper Kettle River	0.33	0.25



NP = Not present

Sequence	Reach Name	Protection Confidence	Current Habitat Confidence
49	Grand Coulee Dam To San Poil Arm	0.33	0.33
50	San Poil Arm To Hawk Creek	0.33	0.33
51	Hawk Creek to Spokane Arm	0.33	0.33
52	Spokane Arm to Ninemile Creek	0.33	0.33
53	Lower Ninemile Creek (Lake to Falls)	0.25	0.21
54	Ninemile Creek 2 (Confined reach)	0.33	0.25
55	Ninemile Creek 3 (Meadow reach)	0.33	0.25
56	South Fork Ninemile Creek	0.33	0.25
57	Upper Ninemile Creek	0.33	0.25
58	Ninemile Creek To Hunter Creek	0.33	0.33
59	Lower Wilmont Creek (Lake To falls)	0.43	0.30
60	Middle Wilmont Creek (Unconfined)	0.43	0.30
61	Upper Wilmont Creek (Higher Gradient)	0.43	0.30
62	Nez Perce Creek	0.37	0.27
63	Bourgeau, Apex, Fish Lakes	NP	
64	Hunters Creek To Gifford's Landing	0.33	0.33
65	Lower Stranger Creek (To Cornstalk)	0.40	0.37
66	South Twin Lake	NP	
67	Upper Stranger Creek	0.37	0.27
68	Lower Cornstalk Creek	0.33	0.25
72	Granite Creek	0.37	0.27
73	Beaver Dam Creek	0.37	0.27
74	Lower Hall Creek (Canyon)	0.37	0.27
75	Middle Hall Creek (Meadow)	0.37	0.27
76	Onion Creek (No. Fork Hall Creek)	0.37	0.27
77	Lower Lynx Creek (Unconfined)	0.37	0.27
78	Middle Lynx Creek (Confined/Falls)	0.37	0.27
79	Upper Lynx Creek	NP	
80	Upper Hall Creek	0.37	0.27
81	Sitdown Creek	0.37	0.27
82	Stall Creek	0.33	0.25
83	West Fork Hall Creek	0.37	0.27
84	North Fork Hall Creek	0.37	0.27
85	Gifford's Landing to Barnaby Creek	0.33	0.33
86	Lafluer and Simpson Lakes	NP	
87	Lower Barnaby Creek (Reservation)	0.25	0.21
88	Upper Barnaby Creek (State)	0.17	0.17
89	Nicholes and Sugar Lake	NP	
90	Barnaby Creek to Colville River	0.33	0.33
91	Colville River To Kettle Falls	0.33	0.33
92	Kettle Falls To Ryan Narrows	0.33	0.33
93	Ryan Narrows To Onion Creek	0.33	0.25
94	Onion Creek To Big Sheep Creek	0.33	0.25
95	Big Sheep Creek To Canada	0.33	0.25
96	Myers/Mary Anne	0.17	0.17
97	Toroda	0.33	0.25
98	Hawk Creek	0.33	0.25



30.4.3.2 Adfluvial Redband/Rainbow Trout

Adfluvial redband/rainbow trout are currently present in 32 of 98 delineated areas within the Subbasin. Historically, the distribution of adfluvial redband/rainbow trout also included Deadman Creek. The comparison between present and reference conditions includes the 32 reaches plus Deadman Creek.

The first 13 reaches listed in Table 30.7, with the exception of Deadman Creek; show habitat diversity as undergoing the largest habitat alteration. Deadman Creek identifies obstructions as the major change experienced within that reach. The reaches listing

habitat diversity as varying the most from the reference are all part of what was historically the mainstem and is now the reservoir, Lake Roosevelt.

The reaches that were listed with the highest ranking for protection primarily consist of northern tributaries of the reservoir. Some of these reaches encompass Boulder, Sheep, Deep, and Nancy creeks (Table 30.8).

The tornado diagram (Table 30.9) and maps (Map UC-3, Map UC-4, located at the end of Section 30) present the reach scores for both current habitat condition (ranging from zero to positive one, Map UC-3) and protection (ranging from zero to negative one Map UC-4). Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

Table 30.7. Ranking of reaches with the largest deviation from the reference habitat conditions for adfluvial redband/rainbow trout in the Upper Columbia Subbasin. A reach rank equal to 1 has the greatest deviation from reference condition in comparison to other reaches. Reach scores range from 0 to 1, with 1 having the greatest deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute having the greatest deviation from reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes equally deviate the most from the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
90	Barnaby Creek to Colville River	1	0.3	7	4	1	2	8	8	4	8	6	2	8
91	Colville River To Kettle Falls	1	0.3	7	4	1	2	8	8	4	8	6	2	8
93	Ryan Narrows To Onion Creek	1	0.3	7	4	1	2	8	8	4	8	6	2	8
94	Onion Creek To Big Sheep Creek	1	0.3	7	4	1	2	8	8	4	8	6	2	8
95	Big Sheep Creek To Canada	1	0.3	7	4	1	2	8	8	4	8	6	2	8
34	Deadman Ck	1	0.3	2	5	5	2	4	10	5	10	5	5	1
49	Grand Coulee Dam To San Poil Arm	7	0.2	7	3	1	2	8	8	3	8	6	3	8
50	San Poil Arm To Hawk Creek	7	0.2	7	3	1	2	8	8	3	8	6	3	8
51	Hawk Creek to Spokane Arm	7	0.2	7	3	1	2	8	8	3	8	6	3	8
52	Spokane Arm to Ninemile Creek	7	0.2	7	3	1	2	8	8	3	8	6	3	8
58	Ninemile Creek To Hunter Creek	7	0.2	7	3	1	2	8	8	3	8	6	3	8
64	Hunters Creek To Gifford's Landing	7	0.2	7	3	1	2	8	8	3	8	6	3	8
85	Gifford's Landing to Barnaby Creek	7	0.2	7	3	1	2	8	8	3	8	6	3	8
53	Lower Ninemile Creek (Lake to Falls)	14	0.2	4	5	2	3	11	7	9	6	8	10	1
41	Lower Kettle River	15	0.2	2	9	2	1	5	5	7	9	7	2	9

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
67	Upper Stranger Creek	16	0.2	5	2	4	5	7	3	9	9	8	9	1
29	Lower Pierre Ck/TouLou Ck	17	0.2	2	6	2	2	5	1	9	9	6	6	9
92	Kettle Falls To Ryan Narrows	18	0.2	7	4	1	2	8	8	4	8	6	2	11
62	Nez Perce Creek	19	0.2	2	8	2	2	6	6	9	11	2	9	1
74	Lower Hall Creek (Canyon)	20	0.2	6	8	6	1	4	5	10	9	2	10	3
59	Lower Wilmont Creek (Lake To falls)	21	0.2	4	9	2	4	6	3	10	8	7	10	1
65	Lower Stranger Creek (To Cornstalk)	22	0.2	2	1	5	2	7	7	10	9	6	10	2
87	Lower Barnaby Creek (Reservation)	23	0.1	2	2	5	2	11	6	9	7	7	9	1
35	Lower Sherman Ck	24	0.1	6	6	6	1	2	2	6	6	4	4	6
68	Lower Cornstalk Creek	25	0.1	3	6	3	6	6	6	6	2	5	6	1
33	Boulder Ck	26	0.1	1	4	4	1	3	9	4	9	4	4	11
32	E Deer Ck	27	0.1	3	3	3	2	3	3	3	3	3	3	1
26	Lower Deep Ck	28	0.1	2	4	2	1	4	4	4	4	4	4	4
39	Nancy Ck	29	0.1	1	4	2	3	4	4	4	4	4	4	4
23	Lower Sheep Ck	30	0.0	4	4	1	1	4	4	4	4	1	4	4
27	Middle Deep Creek	30	0.0	1	4	1	1	4	4	4	4	4	4	4
28	Upper Deep Ck	30	0.0	1	4	1	1	4	4	4	4	4	4	4
31	Little Boulder Ck	33	0.0	2	2	2	1	2	2	2	2	2	2	2

Table 30.8. Ranking of streams whose habitat is most similar to the reference condition for adfluvial redband/rainbow trout in the Upper Columbia Subbasin in comparison to other reaches. A reach rank equal to 1 reveals the reach with current conditions most similar to reference conditions in comparison to other reaches. Reach score ranges from 0 to -1, with -1 having the least deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute being most similar to the reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes are equally the most similar to the reference.

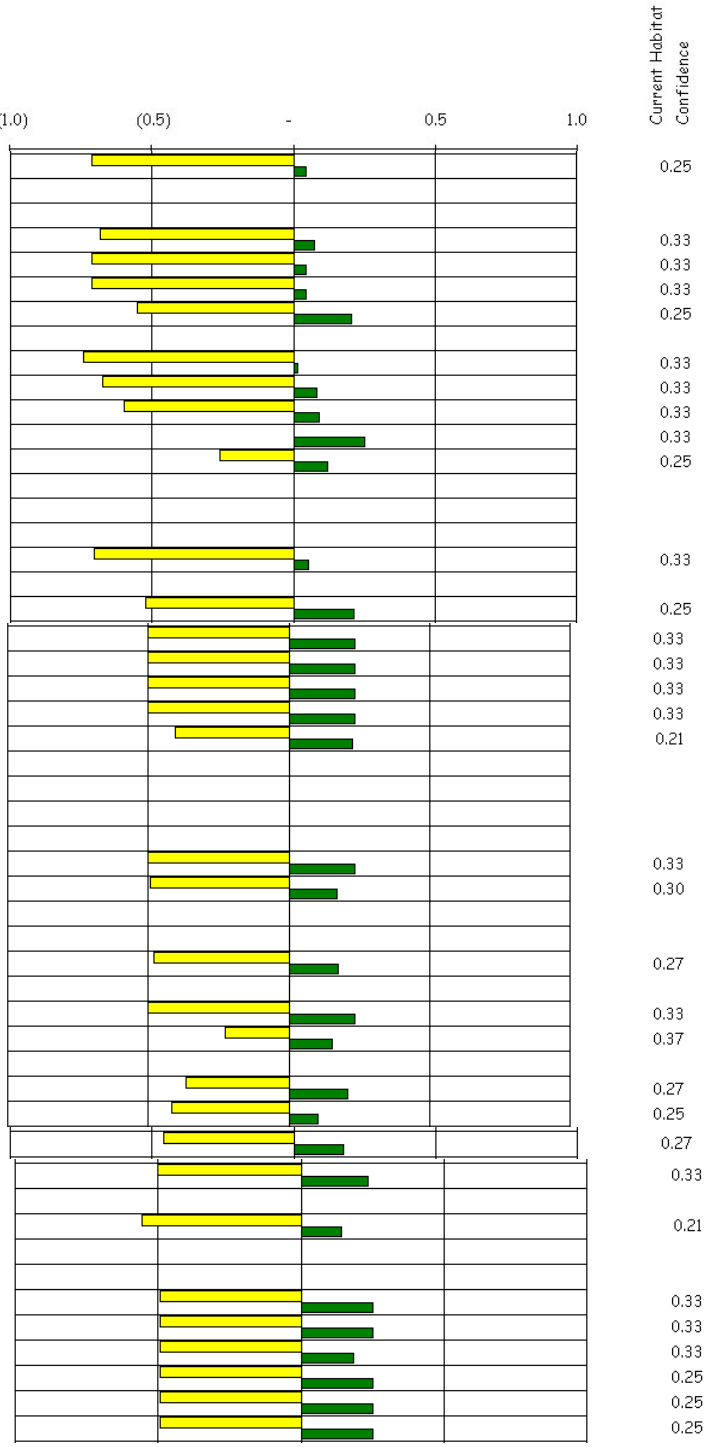
Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
31	Little Boulder Ck	1	-0.74	4	4	4	11	1	1	4	4	4	4	1
23	Lower Sheep Ck	2	-0.71	4	4	9	9	1	1	4	4	9	4	1
27	Middle Deep Creek	2	-0.71	9	4	9	9	1	1	4	4	4	4	1
28	Upper Deep Ck	2	-0.71	9	4	9	9	1	1	4	4	4	4	1
39	Nancy Ck	5	-0.70	11	4	10	9	1	1	4	4	4	4	1
26	Lower Deep Ck	6	-0.68	9	4	9	11	1	1	4	4	4	4	1
32	E Deer Ck	7	-0.67	3	3	3	10	1	1	3	3	3	3	11
33	Boulder Ck	8	-0.60	10	5	5	10	3	1	5	4	5	5	1
87	Lower Barnaby Creek (Reservation)	9	-0.56	7	7	6	7	1	2	3	10	5	3	11
29	Lower Pierre Ck/TouLou Ck	10	-0.55	9	5	9	9	2	5	3	3	5	5	1
41	Lower Kettle River	11	-0.52	8	4	8	11	2	2	6	4	6	10	1
49	Grand Coulee Dam To San Poil Arm	12	-0.50	5	7	11	10	1	1	7	4	6	9	1
50	San Poil Arm To Hawk Creek	12	-0.50	5	7	11	10	1	1	7	4	6	9	1
51	Hawk Creek to Spokane Arm	12	-0.50	5	7	11	10	1	1	7	4	6	9	1
52	Spokane Arm to Ninemile Creek	12	-0.50	5	7	11	10	1	1	7	4	6	9	1
58	Ninemile Creek To Hunter Creek	12	-0.50	5	7	11	10	1	1	7	4	6	9	1
64	Hunters Creek To Gifford's Landing	12	-0.50	5	7	11	10	1	1	7	4	6	9	1
85	Gifford's Landing to Barnaby Creek	12	-0.50	5	7	11	10	1	1	7	4	6	9	1

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
90	Baraby Creek to Colville River	**19**	-0.49	5	7	11	9	1	1	7	4	6	9	1
91	Colville River To Kettle Falls	**19**	-0.49	5	7	11	9	1	1	7	4	6	9	1
92	Kettle Falls To Ryan Narrows	**19**	-0.49	5	7	11	9	1	1	7	4	6	9	1
93	Ryan Narrows To Onion Creek	**19**	-0.49	5	7	11	9	1	1	7	4	6	9	1
94	Onion Creek To Big Sheep Creek	**19**	-0.49	5	7	11	9	1	1	7	4	6	9	1
95	Big Sheep Creek To Canada	**19**	-0.49	5	7	11	9	1	1	7	4	6	9	1
59	Lower Wilmont Creek (Lake To falls)	**25**	-0.49	11	3	9	7	4	8	1	6	5	1	10
62	Nez Perce Creek	**26**	-0.48	5	4	10	5	3	5	1	9	5	1	11
74	Lower Hall Creek (Canyon)	**27**	-0.46	9	6	7	9	1	2	3	5	7	3	11
68	Lower Cornstalk Creek	**28**	-0.42	7	7	7	4	3	7	1	11	6	1	4
53	Lower Ninemile Creek (Lake to Falls)	**29**	-0.40	9	6	9	8	1	2	3	5	4	7	9
67	Upper Stranger Creek	**30**	-0.36	7	10	9	6	3	7	1	5	4	1	11
35	Lower Sherman Ck	**31**	-0.26	6	6	6	6	1	1	3	3	5	6	6
65	Lower Stranger Creek (To Cornstalk)	**32**	-0.23	6	6	6	6	1	2	2	5	4	6	6

Table 30.9. Tornado diagram for adfluvial redband/rainbow trout Upper Columbia Subbasin. Degree of confidence for protection and current habitat conditions range from 0.0 to 1.0 with the greatest confidence equal to 1.0. Protection reach scores are presented on the left side and current habitat reach scores are presented on the right. Negative scores are in parentheses.

NP = Not present

Sequence	Reach Name	Protection Confidence	Current Habitat Confidence
23	Lower Sheep Ck	0.33	0.25
24	Middle Sheep CK	NP	
25	Upper Sheep Ck	NP	
26	Lower Deep Ck	0.50	0.33
27	Middle Deep Creek	0.50	0.33
28	Upper Deep Ck	0.50	0.33
29	Lower Pierre Ck/TouLou Ck	0.33	0.25
30	Upper Pierre Ck	NP	
31	Little Boulder Ck	0.50	0.33
32	E Deer Ck	0.50	0.33
33	Boulder Ck	0.50	0.33
34	Deadman Ck	0.50	0.33
35	Lower Sherman Ck	0.33	0.25
36	Middle Sherman Ck	NP	
37	Upper Cherman Ck	NP	
38	S Fk Sherman Ck	NP	
39	Nancy Ck	0.50	0.33
40	Roper/LaFleur/Mantin cks	NP	
41	Lower Kettle River	0.33	0.25
49	Grand Coulee Dam To San Poil Arm	0.33	0.33
50	San Poil Arm To Hawk Creek	0.33	0.33
51	Hawk Creek to Spokane Arm	0.33	0.33
52	Spokane Arm to Ninemile Creek	0.33	0.33
53	Lower Ninemile Creek (Lake to Falls)	0.25	0.21
54	Ninemile Creek 2 (Confined reach)	NP	
55	Ninemile Creek 3 (Meadow reach)	NP	
56	South Fork Ninemile Creek	NP	
57	Upper Ninemile Creek	NP	
58	Ninemile Creek To Hunter Creek	0.33	0.33
59	Lower Wilmont Creek (Lake To falls)	0.43	0.30
60	Middle Wilmont Creek (Unconfined)	NP	
61	Upper Wilmont Creek (Higher Gradient)	NP	
62	Nez Perce Creek	0.37	0.27
63	Bourgeau, Apex, Fish Lakes	NP	
64	Hunters Creek To Gifford's Landing	0.33	0.33
65	Lower Stranger Creek (To Cornstalk)	0.40	0.37
66	South Twin Lake	NP	
67	Upper Stranger Creek	0.37	0.27
68	Lower Cornstalk Creek	0.33	0.25
74	Lower Hall Creek (Canyon)	0.37	0.27
85	Gifford's Landing to Barnaby Creek	0.33	0.33
86	Lafluer and Simpson Lakes	NP	
87	Lower Barnaby Creek (Reservation)	0.25	0.21
88	Upper Barnaby Creek (State)	NP	
89	Nicholes and Sugar Lake	NP	
90	Barnaby Creek to Colville River	0.33	0.33
91	Colville River To Kettle Falls	0.33	0.33
92	Kettle Falls To Ryan Narrows	0.33	0.33
93	Ryan Narrows To Onion Creek	0.33	0.25
94	Onion Creek To Big Sheep Creek	0.33	0.25
95	Big Sheep Creek To Canada	0.33	0.25



30.4.4 Current Management

In the 1980s, volunteers from Lake Roosevelt piloted a successful net pen rearing rainbow trout program. Fingerling rainbow trout were raised by state and federal hatcheries, transferred to net pens in the fall where the volunteers reared the fish until the following spring and then released them into Lake Roosevelt. Creel surveys performed by Peone et al. (1989) estimated 65,515 rainbow trout were harvested from January to December 1989. In comparison, Harper et al. (1981) estimated anglers harvested 1,517 rainbow trout from April 15, 1981 to September 15, 1981. This large increase in harvest was attributed to the net pen rearing program (Peone et al. 1989). Fishery surveys in 1986 and 1987 conducted by the Upper Columbia United Tribes Fisheries Center indicated net pen reared rainbow trout grew in length at rates ranging from 22 to 36 mm/month and anglers caught most of the fish within 14 months after release (Peone et al. 1989). Prompted by excellent harvest returns and growth rates of net pen reared rainbow trout, additional space was incorporated in the design of 2 kokanee hatcheries constructed in 1990-1991 to rear 500,000 rainbow trout fingerlings annually for Lake Roosevelt net pens. Currently 500,000 rainbow trout are annually stocked into Lake Roosevelt through the Lake Roosevelt Net Pen Project.

Although nonnative coastal rainbow trout are still used in many artificial supplemented stocking efforts, today the WDFW operates one hatchery within the Subbasin that cultures native redband rainbow trout (Phalon Lake). A wild native redband broodstock was established in 1992 to supplement waters in the state of Washington. Stocking of native redbands occurred for three years in both the Kettle River upstream of Curlew, Washington (26,000/yr) and in the Laurier to FDR reach (26,000/yr). These stockings ended in 2003. Stock status of these areas did not occur in 2002 and 2003 because of low flow conditions due to drought, which made electrofishing unfeasible (Curt Vail, Fish Biologist, WDFW, personal communication, 2003). WDFW is currently evaluating the effectiveness of native redband rainbow trout to supplement the Lake Roosevelt rainbow trout fishery.

In addition to the stocking of redband trout, WDFW's management strategies for Kettle River rainbow and redband trout also include restrictive harvest and angling regulations. Previous regulations were very liberal including a year-around season, no minimum length, and liberal eight fish bag limit. These were changed in 1992. Current regulations include a June 1 to October 31 harvest season, and a November 1 to May 31 catch and-release-season. Bait is not allowed and the catch limit is two fish over 12 inches.

Currently the CCT does not have a captive broodstock of native redband trout. The Colville Tribal Hatchery Program evaluated whether captive breeding programs for native adfluvial redband trout stocks would be feasible, but concluded that unpredictable adult returns and collection conditions (high water flows, etc.) may limit the applicability of the program (Kirk Truscott, Fish Biologist, WDFW, personal communication, 2003).

30.5 Focal Species – Kokanee Salmon

Kokanee salmon have been used as partial mitigation for the loss of anadromous salmonids in the region. They are an economically and culturally important species in the

Lake Roosevelt area subsistence and recreational harvest, and may contain important genetic material linking them to historic anadromous sockeye. They were selected as a focal species because of these attributes. The San Poil and Nespelem stocks of kokanee salmon are genetically distinct from the hatchery strains stocked into Lake Roosevelt and are viewed as an important part of the overall diversity of the Upper Columbia Subbasin fish assemblage.

The salmon *Oncorhynchus nerka* occurs in two forms: the anadromous sockeye salmon, and the nonanadromous or resident kokanee salmon. Kokanee are distributed from the Columbia River system in the South to northern Alaska (Meehan and Bjornn 1991). Kokanee are usually smaller than sockeye salmon, since adult rearing takes place in less productive lake environments rather than the productive Pacific Ocean.

Kokanee are fall spawners and may spawn in either tributaries to nursery lakes or within suitable habitat along the shores of lakes. Substrate composition, cover, water quality, and water quantity are important habitat elements for spawning kokanee salmon (Meehan and Bjornn 1991). Planktonic crustaceans are the primary food source for juvenile and adult kokanee salmon (Meehan and Bjornn 1991).

Kokanee are a very popular game fish because of their excellent taste. Native stocks of kokanee salmon within the Columbia River system may be important for the conservation and the possible future reintroduction of sockeye salmon, since stocks of kokanee salmon may contain genetic material from stocks of extirpated sockeye salmon.

30.5.1 Historic Status

Prior to impoundment, the Columbia River provided a migration corridor for abundant stocks of sockeye salmon from as far upstream as British Columbia (Behnke 2002). Historically, the upper Columbia River likely supported large numbers of both life history types for *Oncorhynchus nerka*, resident or adfluvial kokanee and anadromous sockeye salmon (Fish and Hanavan 1948; Behnke 2002). Passage for anadromous sockeye was blocked with the construction and lack of fish passage facilities of both Chief Joseph and Grand Coulee Dams, altering fish assemblages to resident and adfluvial forms. “Landlocked” or kokanee salmon persist in the basin today.

From the 1940’s to the late 1960’s fishery surveys indicated a prominent population of kokanee salmon were abundant in Lake Roosevelt. Large numbers of kokanee were reportedly harvested in the forebay of Lake Roosevelt and high gill net and purse seine catches were made in the forebay in 1966 and 1967 by Bureau of Commercial Fisheries personnel (Scholz et al. 1986). There were additional reports of large numbers of kokanee that emigrated through Grand Coulee Dam during this time period. Interviews of local residents as well as National Park Service and Bureau of Reclamation personnel indicated that there was a salvage fishery for the “tens of thousands to hundreds of thousands” of disabled kokanee in the tailrace of Grand Coulee Dam (Cash 1985). These observations indicate that ecological conditions after 1939 to the late 1960’s were favorable for successful reproduction and survival of kokanee.

Kokanee abundance declined precipitously commencing in 1968, after the reservoir was drawn down for the construction of a third powerhouse at Grand Coulee Dam. The drawdown was thought to negatively effect kokanee in at least two ways; first, through increased entrainment through the dams because of a higher flushing rate; second, by reducing access to tributaries and shoreline areas for spawning (Scholz et al. 1986). Since completion of the third powerhouse, the magnitude and duration of reservoir level fluctuations has been altered (U.S. Geological Survey reports for water years 1960-1984; reviewed by Scholz 1986). Analysis of the increased annual drawdown over time, specifically 1941 to 1976, indicated the kokanee decline after 1968 was because reservoir elevations reduced egg and fry survival rates (Stober 1977).

Stober et al. (1977) evaluated the historical drawdown patterns of Lake Roosevelt in relation to spawning and incubation timing of kokanee and concluded that the decline in kokanee during the 1960's and 1970's could be explained by the impact of the annual drawdown regime on kokanee reproductive success (Scholz et al. 1985). Since 1968, the reservoir has been operated to produce more power, follow flood control rule curves and meet ESA requirements (1990's), thus causing lower water elevations and reduced water retention times from winter through spring. Since kokanee spawn in late fall when water levels are high, maintenance of reservoir levels in winter and spring are critically important to the normal development of eggs and the early life history stages. Given these current reservoir operations, any type of natural production to support a sustainable kokanee salmon fishery would be difficult (Scholz et al. 1986, Peone et al. 1989).

Comparison of zooplankton standing crops in Lake Roosevelt to those of other good kokanee producing lakes indicates zooplankton densities in Lake Roosevelt are greater than, or comparable to, other kokanee lakes (Jagielo 1984, Beckman et al. 1985, Peone et al. 1989, Griffith and Scholz 1991). Taking into account that kokanee are primarily planktivorous feeders and analyzing the high productivity of zooplankton (e.g., *Daphnia* sp.), Beckman et al. (1985) estimated the forage base in Lake Roosevelt could support 16 million fingerlings and 5.9 million adult kokanee (Scholz et al. 1986, Peone et al. 1989).

Nigro et al. (1981) determined that 27,200 m of suitable natural spawning habitat was available for kokanee in Lake Roosevelt and tributaries, and calculated that 181,000 adult fish or 5.4 fish/hectare could be produced by natural spawning if the habitat was fully utilized. Thus, the ability of naturally spawned kokanee to populate the reservoir was far less than the number that could be produced given the food availability in the reservoir. The primary (phytoplankton) and secondary (zooplankton) biological productivity of the reservoir can support 5.9 million adults, whereas the maximum number that can be produced, if all natural spawning habitat is used, is 0.18 million adults (Scholz et al. 1986, Peone et al. 1989). Continued fishery investigations in the 1980s indicated the use of artificial production as a viable way to restore and enhance kokanee salmon in Lake Roosevelt. Following recommendations in a feasibility study by Scholz et al. (1986), measures to construct two hatcheries were amended into the Northwest Power Planning Council 1987 Columbia Basin Fish and Wildlife Program. The measures for the hatcheries included one constructed in 1991 at Galbraith Springs on the Spokane Indian Reservation operated by the Spokane Tribe of Indians (STOI) (Spokane Tribal Hatchery),

and one constructed in 1992 at Sherman Creek (a northern tributary in Lake Roosevelt) operated by the Washington Department of Fish and Wildlife (Sherman Creek Hatchery).

30.5.2 Current Status

The Upper Columbia Subbasin currently supports adfluvial (residualized) stocks of kokanee as well as hatchery-supported stocks originating from Lake Roosevelt, Lake Whatcom and Kootenay Lakes. No anadromous life history types are present, although current populations are thought to possess remnant genetic material of anadromous sockeye salmon making them prone to emigration. Kokanee are considered abundant within the Upper Columbia Subbasin, although recruitment from the natural spawning population is limited. While artificial propagation contributes to the population, entrainment, predation and precocity problems are known limiting factors to the survival/success of hatchery releases.

Stocking of hatchery-reared kokanee from 1988 to 1994 predominantly consisted of fry releases. However, coded wire tag data and a study to chemically imprint and assess smoltification of hatchery produced kokanee indicated that kokanee released as residualized smolts (e.g. yearlings/age 1+) performed more favorably than the kokanee released as fry/fingerlings (age 0+) (Scholz et al. 1993, Tilson et al. 1995). Additionally, entrainment losses and losses from predation were thought to be a greater negative factor for kokanee released as fry as opposed to residualized smolts (Tilson et al. 1995). As a result, hatchery stocking shifted from kokanee fry to residualized smolts/yearling releases. Since 1995 hatchery operations have targeted a release of 1-million yearling (residualized smolt) kokanee.

In 1995 fishery managers implemented a harvest goal of 300,000 fish based upon the theoretical number of fish the impoundment could support. Ongoing fisheries investigations include objectives to develop a model to predict biological responses to reservoir operation, evaluate the effects of releasing hatchery origin kokanee salmon and rainbow trout on the fishery and evaluate success of various stocking strategies to increase fish harvest while maximizing the return of spawning kokanee to egg collection facilities.

Wild kokanee escapement into the San Poil River has been monitored since 1995. These data have suggested kokanee escapement is critically low. However, trapping activities initiated in 2003 and new genetic information (Loxterman and Young 2003) indicate that these data are likely to be flawed (John Arterburn, CCT, personal communication, 2003). Creel, net, and electrofishing surveys conducted by the STOI three times per year, annually from 1988 to current, have revealed the presence of kokanee with intact adipose fins, which suggested wild production or that fish are emigrating from other waters.

Recent genetic information (Loxterman and Young 2003) indicates that there are several distinct kokanee stocks in Lake Roosevelt. A San Poil River naturally reproducing stock contributes to the wild kokanee population in the vicinity of Grand Coulee Dam. Additionally, there is evidence for immigration of kokanee produced in other upper Columbia River sources including Norns Creek and Hill Creek Hatchery, although the

extent that kokanee fall-out from upstream areas is not currently known. Data from this study did not support the hypothesis that kokanee from the Spokane River system or Kootenay Lake in British Columbia are contributing to the kokanee populations in Lake Roosevelt. Results from this study should be taken with caution, due to the inherently large size of Lake Roosevelt and the limited sample size and locations that were used for genetic testing.

30.5.3 Limiting Factors Kokanee Salmon

Kokanee are a lake species that utilize riverine habitat for spawning and rearing, thus were included in the QHA approach to identify potential limiting factors to the life stage, spawning and incubation. Details of the QHA process are provided in Section 3.

Kokanee are currently present in 22 of 98 delineated reaches and watersheds in the Subbasin. The degree of deviation of the current from past habitat conditions were compared for all 22 areas (Table 30.10). The reaches and watersheds most similar to reference conditions are shown in Table 30.11.

Oxygen, followed by pollutants, were listed as the first and second habitat attributes having the greatest degree of deviation from reference conditions for 12 of the 14 top ranked reaches (Table 30.10). This was characteristic for the entire reservoir (Lake Roosevelt). However, interpretation of this analysis should be undertaken with caution. Initial data entry into the QHA model indicating oxygen was a problem was in reference to increased TDG levels identified in Lake Roosevelt. Decreased oxygen levels have not been identified as a problem in Lake Roosevelt (Lee et al. 2003). An increase in fine sediments was listed as the main change for Upper Pierre Creek (ranked 1st), and obstructions were listed as the main change for one of the reaches (ranked 7th) along the mainstem (Table 30.10). The rankings for habitat protection as shown in Table 30.11 found Lower Sheep and Upper Pierre creeks most similar to reference conditions.

Kokanee entrainment through Grand Coulee Dam was not assessed in the QHA analysis, but has been documented to negatively affect the population within Lake Roosevelt. Current kokanee populations in Lake Roosevelt are thought to possess remnant genetic material of anadromous sockeye salmon making them prone to migrating. This tendency to migrate is believed to be influential in the large numbers of kokanee salmon being entrained through Grand Coulee Dam on an annual basis (LeCaire 1999). Entrainment at Grand Coulee, as reported by LeCaire (1999) ranges annually between 211,000 and 650,000 for all fish species combined. Of the total, rainbow trout and kokanee salmon are approximately one half of all entrained fish, with kokanee making up the larger proportion and approximately 33% of all fish being entrained through Grand Coulee Dam (LeCaire 1999).

Table 30.10. Ranking of reaches with the largest deviation from the reference habitat conditions for kokanee salmon in the Upper Columbia Subbasin. A reach rank equal to 1 has the greatest deviation from reference condition in comparison to other reaches. Reach scores range from 0 to 1, with 1 having the greatest deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute having the greatest deviation from reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes equally deviate the most from the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
30	Upper Pierre Ck	1	0.1	7	2	5	1	7	7	2	7	6	2	7
90	Barnaby Creek to Colville River	2	0.1	5	3	5	5	5	5	1	5	4	2	5
91	Colville River To Kettle Falls	2	0.1	5	3	5	5	5	5	1	5	4	2	5
93	Ryan Narrows To Onion Creek	2	0.1	5	3	5	5	5	5	1	5	4	2	5
94	Onion Creek To Big Sheep Creek	2	0.1	5	3	5	5	5	5	1	5	4	2	5
95	Big Sheep Creek To Canada	2	0.1	5	3	5	5	5	5	1	5	4	2	5
59	Lower Wilmont Creek (Lake To Falls)	7	0.1	7	6	7	7	3	2	7	4	5	7	1
49	Grand Coulee Dam To San Poil Arm	8	0.1	5	2	5	5	5	5	1	5	4	2	5
50	San Poil Arm To Hawk Creek	8	0.1	5	2	5	5	5	5	1	5	4	2	5
51	Hawk Creek to Spokane Arm	8	0.1	5	2	5	5	5	5	1	5	4	2	5
52	Spokane Arm to Ninemile Creek	8	0.1	5	2	5	5	5	5	1	5	4	2	5
58	Ninemile Creek To Hunter Creek	8	0.1	5	2	5	5	5	5	1	5	4	2	5
64	Hunters Creek To Gifford's Landing	8	0.1	5	2	5	5	5	5	1	5	4	2	5
85	Gifford's Landing to Barnaby Creek	8	0.1	5	2	5	5	5	5	1	5	4	2	5
41	Lower Kettle River	15	0.1	6	6	6	6	1	1	1	6	5	1	6
87	Lower Barnaby Creek (Reservation)	16	0.1	6	2	6	6	11	3	6	4	5	6	1
53	Lower Ninemile Creek (Lake to Falls)	17	0.1	6	2	6	6	11	4	6	3	5	10	1

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
74	Lower Hall Creek (Canyon)	18	0.1	7	5	7	7	2	3	7	6	4	7	1
65	Lower Stranger Creek (To Cornstalk)	19	0.1	7	1	7	7	3	3	7	6	5	7	1
35	Lower Sherman Ck	20	0.0	5	5	5	5	1	1	5	5	4	3	5
92	Kettle Falls To Ryan Narrows	21	0.0	5	3	5	5	5	5	1	5	4	2	11
23	Lower Sheep Ck	22	0.0	2	2	2	2	2	2	2	2	1	2	2

Table 30.11. Ranking of streams whose habitat is most similar to the reference condition for kokanee salmon in the Upper Columbia Subbasin in comparison to other reaches. A reach rank equal to 1 reveals the reach with current conditions most similar to reference conditions in comparison to other reaches. Reach score ranges from 0 to -1, with -1 having the least deviation from reference. Values associated with each habitat attribute range from 1 to 11, a value of 1 indicates a habitat attribute being most similar to the reference compared to the other attributes within that reach. In some cases multiple habitat attributes have a value of 1 indicating all attributes are equally the most similar to the reference.

Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
23	Lower Sheep Ck	1	-0.73	11	1	9	7	1	1	1	1	10	1	8
30	Upper Pierre Ck	2	-0.63	11	4	9	8	1	1	4	1	10	4	7
87	Lower Barnaby Creek (Reservation)	3	-0.63	10	4	9	4	3	6	1	6	8	1	10
59	Lower Wilmont Creek (Lake To falls)	4	-0.60	11	3	9	5	6	8	1	4	7	1	10
35	Lower Sherman Ck	5	-0.56	10	1	7	8	4	4	1	1	9	4	10
49	Grand Coulee Dam To San Poil Arm	6	-0.36	9	6	9	9	1	1	6	1	5	8	1
50	San Poil Arm To Hawk Creek	6	-0.36	9	6	9	9	1	1	6	1	5	8	1
51	Hawk Creek to Spokane Arm	6	-0.36	9	6	9	9	1	1	6	1	5	8	1
52	Spokane Arm to Ninemile Creek	6	-0.36	9	6	9	9	1	1	6	1	5	8	1
58	Ninemile Creek To Hunter Creek	6	-0.36	9	6	9	9	1	1	6	1	5	8	1
64	Hunters Creek To Gifford's Landing	6	-0.36	9	6	9	9	1	1	6	1	5	8	1
85	Gifford's Landing to Barnaby Creek	6	-0.36	9	6	9	9	1	1	6	1	5	8	1
90	Baraby Creek to Colville River	13	-0.35	9	6	9	9	1	1	6	1	5	8	1
91	Colville River To Kettle Falls	13	-0.35	9	6	9	9	1	1	6	1	5	8	1
92	Kettle Falls To Ryan Narrows	13	-0.35	9	6	9	9	1	1	6	1	5	8	1

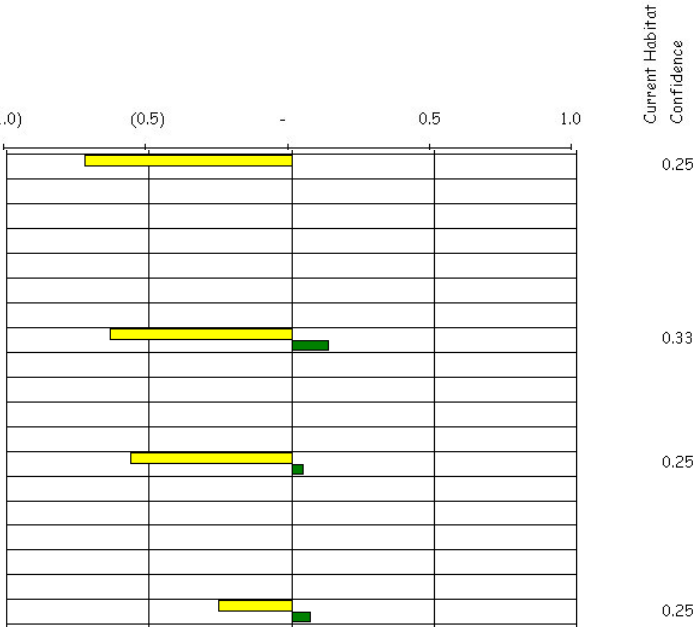
Sequence	Reach Name	Reach Rank	Reach Score	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions
93	Ryan Narrows To Onion Creek	**13**	-0.35	9	6	9	9	1	1	6	1	5	8	1
94	Onion Creek To Big Sheep Creek	**13**	-0.35	9	6	9	9	1	1	6	1	5	8	1
95	Big Sheep Creek To Canada	**13**	-0.35	9	6	9	9	1	1	6	1	5	8	1
53	Lower Ninemile Creek (Lake to Falls)	**19**	-0.35	8	5	8	8	2	6	1	4	2	7	8
41	Lower Kettle River	**20**	-0.26	7	1	7	7	7	7	3	1	3	6	5
74	Lower Hall Creek (Canyon)	**21**	-0.23	6	3	6	6	6	6	1	2	4	4	6
65	Lower Stranger Creek (To Cornstalk)	**22**	-0.20	6	5	6	6	6	6	1	3	2	4	6

The tornado diagram (Table 30.12) and maps (Map UC-5, Map UC-6, located at the end of Section 30) present the reach scores for both current habitat condition (ranging from zero to positive one, Map UC-5) and protection (ranging from zero to negative one, Map UC-6). Scores closest to negative one depict reaches that are most representative of reference habitat conditions. Scores closest to positive one depict reaches with habitat conditions least similar to reference conditions. Confidence scores range from zero to one and are associated with the ratings assigned by local biologists based on documentation or their expert opinion regarding reference and current habitat attributes for each reach.

Table 30.12. Tornado diagram for kokanee salmon in the Upper Columbia Subbasin. Degree of confidence for protection and current habitat conditions range from 0.0 to 1.0 with the greatest confidence equal to 1.0. Protection reach scores are presented on the left side and current habitat reach scores are presented on the right. Negative scores are in parentheses.

NP = Not present

Sequence	Reach Name	Protection Confidence
23	Lower Sheep Ck	0.33
24	Middle Sheep CK	NP
25	Upper Sheep Ck	NP
26	Lower Deep Ck	NP
27	Middle Deep Creek	NP
28	Upper Deep Ck	NP
29	Lower Pierre Ck/TouLou Ck	NP
30	Upper Pierre Ck	0.50
31	Little Boulder Ck	NP
32	E Deer Ck	NP
33	Boulder Ck	NP
34	Deadman Ck	NP
35	Lower Sherman Ck	0.33
36	Middle Sherman Ck	NP
37	Upper Cherman Ck	NP
38	S Fk Sherman Ck	NP
39	Nancy Ck	NP
40	Roper/LaFleur/Mantin cks	NP
41	Lower Kettle River	0.33



NP = Not present

Sequence	Reach Name	Protection Confidence
49	Grand Coulee Dam To San Poil Arm	0.33
50	San Poil Arm To Hawk Creek	0.33
51	Hawk Creek to Spokane Arm	0.33
52	Spokane Arm to Ninemile Creek	0.33
53	Lower Ninemile Creek (Lake to Falls)	0.25
54	Ninemile Creek 2 (Confined reach)	NP
55	Ninemile Creek 3 (Meadow reach)	NP
56	South Fork Ninemile Creek	NP
57	Upper Ninemile Creek	NP
58	Ninemile Creek To Hunter Creek	0.33
59	Lower Wilmont Creek (Lake To falls)	0.43
60	Middle Wilmont Creek (Unconfined)	NP
61	Upper Wilmont Creek (Higher Gradient)	NP
62	Nez Perce Creek	NP
63	Bourgeau, Apex, Fish Lakes	NP
64	Hunters Creek To Gifford's Landing	0.33
65	Lower Stranger Creek (To Cornstalk)	0.40
74	Lower Hall Creek (Canyon)	0.37
75	Middle Hall Creek (Meadow)	NP
76	Onion Creek (No. Fork Hall Creek)	NP
77	Lower Lynx Creek (Unconfined)	NP
78	Middle Lynx Creek (Confined/Falls)	NP
79	Upper Lynx Creek	NP
80	Upper Hall Creek	NP
81	Sitdown Creek	NP
82	Stall Creek	NP
83	West Fork Hall Creek	NP
84	North Fork Hall Creek	NP
85	Gifford's Landing to Barnaby Creek	0.33
86	Lafluer and Simpson Lakes	NP
87	Lower Barnaby Creek (Reservation)	0.25
88	Upper Barnaby Creek (State)	NP
89	Nicholes and Sugar Lake	NP
90	Barnaby Creek to Colville River	0.33
91	Colville River To Kettle Falls	0.33
92	Kettle Falls To Ryan Narrows	0.33
93	Ryan Narrows To Onion Creek	0.33
94	Onion Creek To Big Sheep Creek	0.33
95	Big Sheep Creek To Canada	0.33

Current Habitat Confidence
0.33
0.33
0.33
0.33
0.21
0.33
0.30
0.33
0.37
0.27
0.33
0.21
0.33
0.33
0.33
0.25
0.25
0.25

30.5.4 Current Management

Kokanee management in the Upper Columbia consists of measures to enhance harvest opportunities, maintain genetic integrity of existing stocks and restore adult returns of wild and hatchery populations. Ongoing activities to meet these measures include an artificial production program, conservative harvest regulation of 2 fish per day, a program to evaluate naturally occurring stocks with respect to conservation and/or recovery efforts and a program for monitoring and evaluating the kokanee population reservoir wide. Fishery managers from the STOI, CCT and WDFW meet monthly to coordinate management and research activities. Additional support and peer review is provided by Eastern Washington University while the Lake Roosevelt Forum serves as a public interface mechanism.

Several hatcheries and rearing locations, including Trout Lodge hatchery (private), WDFW-Sherman Creek, Colville, Spokane, Ford hatcheries, Spokane Tribal Hatchery,

and Lake Roosevelt net pen program, culture kokanee for out-planting. However, there are no captive propagation facilities for the expressed culture of native stocks to prevent extirpation.

Due to the recent genetic analysis (Loxterman and Young 2003) of kokanee populations in Lake Roosevelt, current management efforts are aimed at conserving the genetic structure of the native population, while collecting new information on the origin of kokanee in Lake Roosevelt.

30.6 Focal Species – Chinook salmon

Chinook salmon were selected as a focal species for the Upper Columbia Subbasin because of their cultural significance to the Upper Columbia United Tribes, their potential recreational value as a sport fish, and to address concerns regarding native species conservation and to be in alignment with Northwest Power and Conservation Council (Council) program to reintroduce salmon where feasible.

Chinook salmon are sometimes referred to as king, tyee, spring, and quinnat salmon. The Chinook salmon is indigenous to the northern half of the Pacific Coast of North America (Meehan and Bjornn 1991), and are of great commercial and recreational importance within this area. Chinook salmon are most abundant in the large river systems, although they may be present in various sized rivers and streams. Although they have been stocked into many lakes and reservoirs throughout North America, they are usually not self-sustaining in these systems.

Chinook salmon are anadromous spawning in freshwater systems and rearing as adults in the Pacific Ocean. Chinook salmon spend between 2 and 8 years in the Pacific Ocean and display a great deal of variation in the timing of adult migration, juvenile migration, and spawning. One hundred eight stocks of Chinook salmon were identified in the State of Washington alone (Wydoski and Whitney 2003). Historically, Chinook salmon migrated to the headwaters of the Columbia River in Canada, but since the construction of Grand Coulee Dam and the subsequent construction of Chief Joseph Dam, their upstream terminus is river mile 545 (Wydoski and Whitney 2003).

30.6.1 Historic Status

Prior to hydroelectric development, Chinook salmon migrated as far inland up the Columbia River as British Columbia with estimates of several million adults making annual migrations (Behnke 2002). Chinook were the most plentiful and typically ran from June through September, peaking in mid- to late June and again in August, (Scholz et al. 1985). However, salmon were available from May through November (Ray 1954).

Summer and fall Chinook salmon were originally treated as separate populations by WDFW (NRC 1996). However, Utter et al. (1993) considered upriver brights (URB) to consist of a continuous population. Current listings (NMFS 1998) indicate fish from upriver areas above Chief Joseph and Grand Coulee dams to have been within the Upper Columbia Summer/Fall Chinook ESU.

30.6.2 Current Status

The construction of Chief Joseph and Grand Coulee dams and the lack of fish passage facilities blocked migration of Chinook salmon and extirpated them from the Subbasin. Current trends in abundance and distribution of resident Chinook salmon above Chief Joseph Dam is unknown but presumed to be minimal. Genetic variation and diversity historically present within Chinook salmon stocks above Chief Joseph and Grand Coulee dams are presumed to have been lost.

30.6.3 Limiting Factors Chinook Salmon

The primary limiting factor for Chinook salmon in the Upper Columbia Subbasin is the lack of fish passage facilities at both Chief Joseph and Grand Coulee dams. Any reintroduction program for anadromous stocks of Chinook salmon in the Subbasin would likely fail without some type of fish passage program at these dams. Efforts to introduce a naturalized resident population of Chinook salmon failed in 1977 and would likely fail again based on current knowledge of fish entrainment through Grand Coulee Dam. Chinook salmon are currently listed as extirpated in the Upper Columbia Subbasin. Efforts to restore habitat for other salmonid species would likely benefit freshwater Chinook habitat, however until the lack of fish passage on the mainstem Columbia River is addressed these benefits are academic. Because Chinook salmon have no current distribution in the Upper Columbia Subbasin they were not analyzed using the QHA model.

30.6.4 Current Management

There is no current management for Chinook salmon in the Upper Columbia Subbasin since Chinook salmon are present in extremely low numbers above Grand Coulee Dam. The desire on the part of the Upper Columbia United Tribes is that Chinook salmon will be re-established, possibly with construction of fish passage at Chief Joseph and Grand Coulee.

30.7 Focal Species – Pacific Lamprey

Pacific lamprey were selected due to their cultural significance and subsistence value historically to the Upper Columbia United Tribes, and to address concerns regarding native species conservation.

Pacific lamprey are found in streams from southern California to the Gulf of Alaska (Wydoski and Whitney 2003). In Washington state, Pacific lamprey are found in most large coastal and Puget Sound Rivers and occurs long distances inland in the Columbia, Snake, and Yakima River systems (Wydoski and Whitney 2003).

Pacific lamprey are anadromous and rear as adults in the Pacific Ocean. Adults are parasitic, feeding on the body fluids of various species of fish. Adults reach lengths of 30 inches and a weight of about 1 pound (Wydoski and Whitney 2003). Unlike Pacific salmon, Pacific lamprey may be able to spawn more than once (Wydoski and Whitney 2003). The importance of Pacific lamprey predation in the Pacific Ocean has not been clearly evaluated (Wydoski and Whitney 2003), although biologists suspect there might be significant effects on some fish populations.

30.7.1 Historic Status

Historically, Pacific lamprey were found as far upstream as Kettle Falls on the Columbia River and Spokane Falls on the Spokane River (Wydoski and Whitney 2003). Completion of Grand Coulee and Chief Joseph dams blocked the upstream migration of Pacific lamprey.

Pacific lamprey were utilized by Upper Columbia River Tribes for food. Preservation of the meat was accomplished through smoking, sun drying, and salting practices (Wydoski and Whitney 2003). It has been reported that Pacific lamprey were just as valuable as salmon to some Upper Columbia River Tribes (Landeen and Pinkham 1999 cited in Wydowski and Whitney 2003). Commercial fisheries for Pacific lamprey existed in the Lower Columbia as late as the 1940's, when lamprey were used for oil, animal food, and fertilizer (Wydoski and Whitney 2003). However, the importance of the Pacific lamprey fishery was likely overshadowed by the size and utilization of the salmonid fishery.

30.7.2 Current Status

Pacific lamprey were extirpated from the Upper Columbia with the construction of Grand Coulee and Chief Joseph Dams. Although lamprey have been known to ascend the faces of dams, they have not been observed at or above Grand Coulee Dam (Curt Vail, Fish Biologist, WDFW, personal communication, 2004).

30.7.3 Limiting Factors Pacific Lamprey

The primary limiting factor for Pacific lamprey in the Upper Columbia Subbasin is the lack of fish passage at both Chief Joseph and Grand Coulee dams. Pacific lamprey are currently listed as extirpated within the Upper Columbia Subbasin, and were not analyzed using the QHA model.

30.7.4 Current Management

Currently, the Pacific lamprey does not exist in the Upper Columbia and therefore is not managed. Establishment of Pacific lamprey above Chief Joseph Dam could create a need for management in the future.

30.8 Focal Species – Burbot

Burbot were selected as a focal species for their ecological significance, their native species status, and their potential recreational importance as a sport fish. Although burbot are not as sought after by recreational anglers as the salmonids in the region, they are excellent table fare. More research needs to be conducted to truly understand the status of burbot in this region. Burbot were not analyzed by the QHA model in this assessment, as the QHA model was developed for salmonid fishes and would not effectively identify limiting factors for populations of burbot in the Upper Columbia Subbasin.

30.8.1 Historic Status

Distribution of burbot is circumpolar in the northern hemisphere. Little is known about burbot in the Upper Columbia Subbasin, besides that they are found both in Lake

Roosevelt and the Columbia River upstream of the reservoir. Early systematic studies placed burbot into three distinct subspecies with only one of these subspecies found in North America, *Lota lota lacustris*. Current evidence suggests the sub-specific designation is unwarranted (Scott and Crossman 1973).

Burbot are benthic feeders that reside in deep waters in lakes or rivers and are not considered migratory. Sexual maturity is reached between age 2 and age 4. Burbot spawn during the winter from mid-December to early April. Spawning habitat conditions include mostly shallow waters (0.3-1.5 m) and clean substrate (sand, gravel and stones) (Morrow 1980).

Prior to 1969, burbot were not managed in Washington State (Polacek et al. 2004). Since 1969, burbot have been listed as a game fish in Washington State and harvest limits were imposed in 1998. Burbot are not known to have been stocked in the Upper Columbia Subbasin.

30.8.2 Current Status

Little is known regarding burbot biology within the Upper Columbia Subbasin. Population status, abundance, and trends are unknown. Abundance appears to be fairly stable with comparison to other harvest and species composition data (WDFW catch data for Lake Roosevelt). Carrying capacity and current habitat condition for burbot remains relatively unknown within the Subbasin. Research on burbot in Lake Roosevelt was conducted from 1997-2001, with BPA funding through the Lake Roosevelt Fishery Evaluation Program. Preparation of the final report of this research is in progress and the results will become available upon its completion.

30.8.3 Current Management

Currently there is a daily catch limit of five burbot per day with no minimum size requirement. This was increased from previous regulations of two per day in an attempt to increase angler interest and harvest for burbot (WDFW 2003). Some waters within the Subbasin allow setlines for the take of burbot, although it is now allowed in Lake Roosevelt. Of the eleven known populations of burbot in the State of Washington, one is considered in critical condition (Banks Lake), one is healthy (Lake Roosevelt), and the status of the others is currently not known (Bonar et al. cited in Polacek et al. 2004). No hatchery production or current captive breeding programs operate within the Upper Columbia Subbasin. Current management direction is to maintain the harvest regulations that are in place.

30.9 Environmental Conditions

The Subbasin consists of the impounded portion of the Columbia River above Grand Coulee Dam (reservoir habitat), several tributaries that drain into the lake (riverine habitat), and many basin lakes within the watershed that are heavily used for Tribal subsistence and recreational harvest.

30.9.1 Environmental Conditions within the Subbasin

30.9.1.1 Lake Roosevelt

Lake Franklin D. Roosevelt (Lake Roosevelt) reaches upstream from Grand Coulee Dam 151 miles to the Canadian border. Approximately 494 miles of shoreline exists, where sixty-five tributaries streams contribute their flow and biomass to the fishery in the lake (LeCaire and Peone 1991). Grand Coulee Dam inundated 135 miles of habitat in the mainstem Columbia River from the dam to within 15 miles of the Canadian border (USGS 2004), 28 miles of the lower Spokane River, 12 miles of the San Poil River, and 15 miles of the Kettle River as well as numerous other tributaries. What had been a shallow, free-flowing river was converted into a deep reservoir. Native westslope cutthroat trout, redband trout, bull trout, and mountain whitefish that were adapted to a fluvial environment were probably selected against in relation to other native and nonnative fishes following impoundment. Selection against native salmonid fish populations, combined with fish entrainment has resulted in declining native fish populations. Furthermore, resident fish species were impacted through lost productivity (absence of marine-derived nutrients from anadromous fish) and habitat degradation related to land-use practices (for example, agriculture, hydro-operations, grazing, logging, and municipal development).

The lacustrine habitats of Lake Roosevelt do not exhibit physical characteristics normally associated with natural lake environments. In high water years, when the spring freshet is anticipated to be large, reservoir levels have been drawn down more than 80 feet and refilled over the span of three to five months. These drawdowns decrease invertebrate productivity, eliminate littoral habitat used as nursery areas, and therefore are limiting production in Lake Roosevelt (Cichosz et al. 1999; Underwood and Shields 1995; Griffith and Scholz 1991). Additionally, the drawdowns likely increase fish entrainment (LeCaire 1999). Lake Roosevelt, which is a relatively deep reservoir, does not thermally stratify (McLellan et al. 2003). The variable habitat conditions exhibited by Lake Roosevelt are due to the operations of Grand Coulee Dam for flood control and downstream flow augmentation. As a result, current practices severely impact resident fish populations and limits fisheries managers in their ability to achieve objectives and goals set by their respected Tribes or agencies.

Although Lake Roosevelt supports relatively healthy fisheries, portions of the reservoir are heavily contaminated with trace elements that were discharged into the Columbia River from mining activities. A smelter in Trail, British Columbia owned by Teck Cominco Ltd. legally released approximately 360 metric tons per day of smelter slag into the Columbia River from 1900 to 1998 (USGS 2004). Contamination has been found downstream in the U.S. portions of Lake Roosevelt. A study by the USGS reported that Lake Roosevelt bed sediments were contaminated with arsenic, lead, and other metals based upon high concentrations, impaired benthic invertebrate communities, and laboratory sediment bioassays (USGS 2004). Although the impacts of the contaminants on aquatic life have not been well documented, man aquatic species may be greatly affected by these contaminants, along with wildlife that depend on the system. While there has been a reduction in point source discharge of metals to the upper Columbia River, there is a substantial quantity of metals residing in the bottom sediments of Lake

Roosevelt. The threat from the remobilization and availability of metals may be most pronounced in shallow, backwater habitats that are dominated by fine-grained sediment and higher biological productivity.

In 1999, the CCT petitioned the Environmental Protection Agency (EPA) to conduct an assessment at the Upper Columbia River. The petition expressed concerns about risks to human health and to the health of the environment from contamination in the river. In December 2000, EPA completed a preliminary assessment of the Upper Columbia River and determined that a sampling investigation was necessary. In mid-2001, EPA collected samples from the Upper Columbia River to learn more about the types and amounts of pollution in the sediments. The results of the sampling were released in November 2002 in a draft Site Inspection Report. Sampling results suggest that further investigation of contamination in the Upper Columbia River is warranted.

Negotiations about cleanup measures are ongoing. In December 2002, the U.S. Environmental Protection Agency asked Teck Cominco to pay for a study of the contamination. However, jurisdictional issues remain and, as of this writing (February 2004), no agreement on studies or cleanup has been reached. In 2004, EPA is contracting a six-part study of existing information on the river. Also, the USGS is continuing to study the effects of airborne contaminants.

30.9.1.2 Colville River

Colville River discharge is driven by a snowmelt regime. The high-flow period occurs in the spring as a result of melting of the previous winter snow pack, combined with spring rainfall. April is the highest month for discharge, while August is the lowest. The majority of the tributaries to the Colville River are small, generally averaging less than 20 cfs, except for Chewelah Creek, Little Pend Oreille River, and Mill Creek. These three large streams account for just over half of the Colville River discharge. Sheep Creek, a headwater stream, is the only other tributary accounting for more than 5 percent of the river volume, at about 5.9 percent. Eighty-two percent of the land cover for the Colville River basin is forest, shrubland, woody wetlands, and upland grasses (WDOE 2002). Most of the remaining area is divided between agriculture and transitional or barren grounds. Urban, residential, commercial/industrial, transportation, and recreational grasses (lawns) cover less than 2 percent of the basin. The urban/residential areas of the watershed are near the population centers of Chewelah, Colville, Kettle Falls, Springdale, and along portions of the highway corridors. The subbasins are rural/residential, with agriculture the predominant land use along the valley bottoms and on some terraces higher up. The uplands account for approximately 75 percent of the basin and are dominated by evergreen forests.

Physical habitat in nearly all 53 miles of the Colville River has been severely degraded. In most areas, ditching and tiling have drained wetlands, and pasture or croplands extend to the edge of eroding banks. Most of the riparian vegetation has been removed and in many areas livestock have direct access to the river. This has resulted in increased levels of sediment loading and above normal turbidity. Channelization and diking of the Colville River has decreased complexity and increased embeddedness, severely limiting

habitats necessary for native salmonids at virtually every life stage. Similar conditions exist for many of the lower sections of tributaries.

The Colville River is listed in Section 303(d) of the Federal Clean Water Act for temperature, fecal coliform bacteria, dissolved oxygen, chloride, pH, and ammonia-N. Tributaries of the Colville River in Section 303(d) of the Federal Clean Water Act include: Blue Creek (dissolved oxygen and fecal coliform), Chewelah Creek (fecal coliform, dissolved oxygen, pH, and temperature), Cottonwood Creek (fecal coliform and temperature), Haller Creek (fecal coliform), Huckleberry Creek (fecal coliform), Jump off Joe Creek (fecal coliform) Little Pend Oreille River (fecal coliform), Mill Creek (fecal coliform and pH), Sheep Creek (dissolved oxygen and fecal coliform), Sherwood Creek (fecal coliform), Stensgar Creek (dissolved oxygen, fecal coliform and temperature), and Stranger Creek (fecal coliform).

30.9.1.3 Kettle River

A significant tributary to Lake Roosevelt, the Kettle River flows out of Canada at Ferry, Washington, back into Canada at Danville, Washington, and then back into Washington at Laurier, Washington. The over 25 miles of river between Ferry and Danville is impacted by agriculture and residential development. Two county roads traverse most of the stream course on both sides if the river. Gradient of the river is flat and the channel is broad with few meanders. Habitat complexity is low with little large woody debris. Few deep pools provide limited trout habitat. Areas of riprap along the county roads provide limited riffle habitat.

The river from Laurier to Lake Roosevelt courses through over 25 miles of mostly scenic forested terrain. The gradient is steeper and the river is generally narrower. More pools and riffle and run habitat provide more trout habitat than the upper portion. However, large woody debris is still lacking (Curt Vail, Fish Biologist, WDFW, personal communication).

The largest towns located in the Kettle River watershed are just across the border in Canada (Grand Forks, Greenwood and Midway). Within Washington, small towns with populations of less than 1,000 are located along the Kettle River valley. About 75 percent of the watershed is federally managed forest including Okanogan and Colville National forests. In the Kettle River, water quality generally meets State water quality standards, with the exception of high in-stream temperatures during the summer months in the lower reach of the river between Laurier and the confluence with the Columbia River. Additionally, non-point source water quality degradation in the Curlew Lake area has been documented for bacteria, turbidity and excess nutrients (WDOE 1995).

The total flow of the river, while varying on an annual basis, has declined just slightly since the 1950s similar to trends in precipitation. However, declines have been somewhat greater at Laurier, compared to Ferry, indicating greater declines in flow in the lower portions of the river, which includes Washington (WDOE 1995). Trends in tributary streams have not been identified due to lack of long-term stream flow data.

Some tributary streams get extremely low or cease to flow in late summer. These include streams located in the central portion of the watershed, including the Curlew Creek area, coinciding with an area of lower precipitation and higher summer evaporation. Although stream flow data are incomplete for these tributary streams, the low flows indicate seasonally limited water availability (WDOE 1995).

30.9.1.4 Other Waters

Tributary habitat on National Forest Service lands range from poor to very good depending upon past and present level of activities. In general, where habitat is poor to fair, road densities are high and many roads are located within the riparian areas of these tributaries. In addition, stream habitat is degraded where the riparian habitat is easily accessible to livestock and in many cases the vegetation is overgrazed (Tom Shuhda, Fish Biologist, Colville National Forest, personal communication, 2003). The natural shape of the valley and channel type form relatively wide and shallow reaches in many streams. Stream temperatures have increased in areas due to the higher bankfull width-to-depth ratio and degraded riparian areas. The resulting warmer water reaches make for marginal salmonid habitat during the hot summer months (Tom Shuhda, Fish Biologist, Colville National Forest, personal communication, 2003). Good habitat areas typically have adequate canopy shading, little disturbance in the riparian area, and low levels of embeddedness.

30.9.1.5 Curlew Lake

Curlew Lake, the largest lake in the north half of Ferry County is located approximately five miles north of Republic, Washington. Combined with Lake Roberta, which is connected via a short channel, it is 921 surface acres. Maximum depth is 130 ft. The lakes' long axis is oriented north and south and is approximately five miles long. Lake elevation is 2,333 ft msl. The highest geographical point in the watershed at 7,135 ft is Copper Butte; with several other high points between 5,101 ft and 7,000 ft. Tributaries to the lake are intermittent with the exception of Trout Creek, which enters the lake from the west. Major land uses in the lake basin include timber harvesting, livestock grazing, and intermittent mining operations.

Curlew Creek is the only outlet and drains into the Kettle River to the north at the town of Curlew. The Kettle River enters the Columbia River between Kettle Falls and Boyds, Washington.

30.9.1.6 Other Lakes

Seven lakes on the Colville Indian Reservation are located within the Subbasin. Most are closed basin lakes with Chara Bench traits and limnological conditions characteristic of eutrophic or meso-eutrophic productivity status. These characteristics, combined with hot arid climatic conditions, create habitat conditions not optimal for salmonids. As early as May, the temperatures in the epilimnion (comprises up to 10 meters of the water column) of these lakes reach over 20º C. There is generally a two-meter thermocline with a 15-degree temperature change between the hypolimnion and epilimnion. The hypolimnion characteristically has lower dissolved oxygen (DO) levels (<5 mg/l) due to a relatively high biological oxygen demand (BOD), nutrient loading, and nutrient cycling.

Off reservation lakes within the Subbasin are managed by WDFW. There are thirty-five lakes managed for trout fisheries. Most are small, relatively pristine waters, located predominantly on the Colville National Forest. These lakes are stocked annually from the WDFW Colville Trout Hatchery with westslope cutthroat and rainbow trout. Over 1 million trout are stocked to provide a recreational fishery (Curt Vail, WDFW, personal communication, 2003).

30.9.2 Out-of-Subbasin Effects and Assumptions

Hydroelectric development along the Columbia River upstream and downstream of the Upper Columbia has drastically altered the historic hydrograph of the region along with the structure and function of the aquatic ecosystem. There are an additional ten dams downstream of Grand Coulee Dam that have undoubtedly had significant impacts on the Upper Columbia Subbasin, which must be taken into consideration with the potential reintroduction of migratory salmon, steelhead, and Pacific lamprey. The blocked anadromous runs of salmon and steelhead have eliminated a source of marine-derived nutrients to an already oligotrophic system. Studies have suggested that marine-derived nutrients are an important component of the nutrient cycle for fish health and survival (Stockner 2003). Due to the elimination of marine-derived nutrients, primary and secondary productivity has likely been affected, although not quantified. Other out-of-Subbasin influences include activities upstream in the Spokane Subbasin.

30.10 Limiting Factors and Conditions

30.10.1 Physical Habitat Alterations/Limiting Habitat Attributes

QHA was utilized to compare historic versus current physical stream conditions with respect to 11 habitat attributes. Details of the analysis method are provided in Section 3. QHA model does not determine which habitat attributes are most biologically limiting, but does identify which physical attributes have undergone the greatest deviation from reference conditions. These results, coupled with knowledge of local biologists and biological status of the focal species, can assist in identifying key limiting factors. This section provides QHA results on a Subbasin level for Upper Columbia Subbasin. Results specific to each focal species are discussed in each focal species section.

In the Upper Columbia Subbasin most areas were delineated into smaller watersheds with the exception of Sherman, Sheep, Deep, and Cottonwood creeks, which were delineated into 12 reaches (Map UC-7, located at the end of Section 30). Using the QHA model, habitat conditions were analyzed where rainbow (adfluvial and resident) and kokanee were historically and are currently present. Table 30.13 presents reaches having less than optimal habitat attributes in the reference condition.

Table 30.13. Reaches that were ranked as containing less than optimal habitat conditions in the reference condition

Sequence	Reach Name	Habitat Attribute < Optimal
21	Deep Ck	Obstructions
24	Middle Sheep Ck	Obstructions
25	Upper Sheep Ck	Obstructions
33	Boulder Ck	Obstructions
36	Middle Sherman Ck	Obstructions
53	Lower Ninemile Creek (Lake to Falls)	Riparian Condition, High and Low Flow, Pollutants
54	Ninemile Creek 2 (Confined reach)	Fine Sediments, Low and High Flow, Low Temperature, Pollutants, Obstructions
55	Ninemile Creek 3 (Meadow reach)	Riparian Condition, Habitat Diversity, Fine Sediments, Low and High Flow, Low Temperature, Pollutants
56	South Fork Ninemile Creek	Riparian Condition, Habitat Diversity, Low and High Flow, Low Temperature, Pollutants
57	Upper Ninemile Creek	Fine Sediments, Low and High Flow, Low Temperature, Pollutants
59	Lower Wilmont Creek (Lake To falls)	Riparian Condition, High and Low Flow, Low Temperature
60	Middle Wilmont Creek (Unconfined)	Habitat Diversity, Fine Sediments, High and Low Flow, Low Temperature
61	Upper Wilmont Creek (Higher Gradient)	High and Low Flow, Low Temperature
62	Nez Perce Creek	Habitat Diversity, High and Low Flow, Low Temperature
65	Lower Stranger Creek (To Cornstalk)	Riparian Condition, Channel Stability, Habitat Diversity, Low and High Flow, Low Temperature, Obstructions
67	Upper Stranger Creek	Fine Sediment, High and Low Flow, Low Temperature
68	Lower Cornstalk Creek	Channel Stability, Fine Sediment, High and Low Flow, Low Temperature
70	Upper Cornstalk Creek	Riparian Condition, Channel Stability, Habitat Diversity, Fine Sediment, High and Low Flow, Low Temperature
72	Granite Creek	Habitat Diversity, Fine Sediment, High and Low Flow, Low Temperature
73	Beaver Dam Creek	Habitat Diversity, High and Low Flow, Low Temperature
74	Lower Hall Creek (Canyon)	Riparian Condition, Habitat Diversity, Low Flow, Obstructions
75	Middle Hall Creek (Meadow)	Habitat Diversity, Fine Sediment, Low Flow, Low Temperature
76	Onion Creek (No. Fork Hall Creek)	Riparian Condition, Habitat Diversity, Low and High Flow, Low Temperature, Obstructions
77	Lower Lynx Creek (Unconfined)	Riparian Condition, Habitat Diversity, Low and High Flow, Low Temperature, Obstructions
78	Middle Lynx Creek (Confined/Falls)	Low Flow, Low Temperature
79	Upper Lynx Creek	Habitat Diversity, Low and High Flow, Low Temperature, Obstructions
80	Upper Hall Creek	Riparian Condition, Habitat Diversity, Low Flow, Low Temperature, Obstructions
81	Sitdown Creek	Riparian Condition, Fine Sediments, Low Flow, Low Temperature, Pollutants
82	Stall Creek	Channel Stability, Habitat Diversity, High and Low Flow, High and Low Temperature
83	West Fork Hall Creek	Habitat Diversity, Low Flow, Low Temperature, Pollutants
84	North Fork Hall Creek	Habitat Diversity, High and Low Flow, Low Temperature
87	Lower Barnaby Creek (Reservation)	Low and High Flow, Low Temperature
88	Upper Barnaby Creek (State)	Habitat Diversity, Fine Sediment, High and Low Flow, Low Temperature, Obstructions

Sequence	Reach Name	Habitat Attribute < Optimal
92	Kettle Falls To Ryan Narrows	Obstructions

The habitat parameters with the greatest deviation from reference conditions vary by species and are presented in Table 30.14. This table should be interpreted as an indication of the types of habitat parameters that are problematic for the focal species in the Subbasin as a whole. Some reaches had more than one habitat parameter that was ranked as being equally deviant from the reference, hence the number of reaches listed adds up to more than the total number of reaches ranked. Most reaches had more than one habitat parameter that is currently ranked less than the reference. Table 30.14 only lists those habitat parameters that had the greatest deviation from reference, not all the parameters that could be less than optimal.

Degradation of habitat diversity and riparian areas are by far the leading habitat attributes that have most greatly impacted habitat quality for resident redband/rainbow trout in the Subbasin (Table 30.14). Similarly, habitat diversity as well as obstructions and fine sediments are the habitat attributes deviating most frequently and to the greatest degree from reference conditions with respect to the analysis of adfluvial redband/rainbow trout (Table 30.14). While oxygen and obstructions were the most common habitat attribute identified as deviating the greatest from the reference condition when evaluating kokanee salmon.

Table 30.14. Habitat conditions with the greatest deviation from reference conditions as presented in the QHA model output for each focal species in Upper Columbia Subbasin. In parentheses is the number of reaches or watersheds with the particular habitat attribute exhibiting the largest deviation within that area.

Adfluvial Redband/Rainbow (33)	Resident Redband/Rainbow (68)	Kokanee (22)
Habitat Diversity (13)	Habitat Diversity (32)	Oxygen (13)
Obstructions (8)	Riparian Conditions (22)	Obstructions (5)
Fine Sediments (5)	Obstructions (21)	Fine Sediments (1)
Riparian Condition (2)	Channel Stability (8)	Pollutants (1)
Channel Stability (1)	Fine Sediment (8)	High and Low Flows (1)
Low Flow (1)	Low Flow (7)	Channel Stability (1)
	High Temperature (5)	
	Oxygen (2)	
	Low Temperature (1)	
	Pollutants (1)	

30.10.2 Description of Historic Factors Leading to Decline of Focal Species

30.10.2 Lake Roosevelt

The most significant limiting factor to fish populations managed in Lake Roosevelt is hydro-operations. In 1999, collection reports from the Rock Island Dam bypass facility confirmed the presence of 986 kokanee and 234 floy-tagged rainbow trout that were released behind Grand Coulee Dam in 1998 and 1999 (LeCaire 1999). Entrainment of

fish, specifically rainbow trout and kokanee salmon, severely limits the fishery in Lake Roosevelt.

In addition to increased emigration, Grand Coulee Dam and other upriver hydroelectric project operations (outside of the Intermountain Province) are detrimental to habitat-related parameters, therefore likely limiting fish populations. Spilling at upriver projects creates total dissolved gas (TDG) levels in Lake Roosevelt that exceed clean water standards (>110 percent). It is hypothesized that these elevated levels are causing significant mortality to certain fish species throughout the reservoir, including net pen fish that cannot avoid high levels of TDG because of their confinement to surface waters. Furthermore, drastic fluctuation of reservoir elevation frequently changes the littoral zone, thus limiting productivity. The lack of stable littoral habitats in the lake has resulted in virtually no macrophyte communities and severely depressed benthic macroinvertebrate communities. Ultimately, the lack of littoral habitats limits fish communities that depend on such habitats. Impoundment has also eliminated salmonid spawning and rearing habitats by replacing rapids and gravel bars with deep zero velocity lacustrine environments with sand as the dominant substrate. Therefore the lack of suitable spawning and rearing habitats are limiting natural salmonid production in the inundated sections of the Columbia River. Changing flow dynamics within the reservoir has the potential to dewater salmonid redds and increases silt deposition over incubating eggs.

Since Lake Roosevelt has short water retention times (8-65 days), the reservoir could lack dimictic traits characteristic of deep lacustrine environments in eastern Washington. The lack of stratification during the summer creates uniform water temperatures throughout the water column. As a result, the uniform temperature regime creates limited refugia of preferred temperature areas that fish are known to prefer (Cichosz et al. 1999).

Data presented in Cichosz et al. (1999) suggests that periphyton growth and colonization in Lake Roosevelt appeared to be inhibited during summer drawdowns and was benefited during refill conditions in the lake. Efforts to model zooplankton density and biomass to environmental variables (chlorophyll a, secchi depth, daily WRT, daily temperature, reservoir inflow, reservoir outflow, and reservoir elevation) were generally unsuccessful using simple regression analyses (Cichosz et al. 1999). On the other hand, Underwood and Shields (1995) were able to show that zooplankton density generally decreased as water retention time decreased below 30 days. Zooplankton is the primary food source for kokanee, rainbow trout, suckers, whitefish and fry fishes of all species (Cichosz et al. 1999). Thus, hydro-operations, which reduce water retention time, reduce food availability for fish and reduce fish carrying capacity of the lake.

Zooplankton abundance (fish food availability) does not appear to be an overriding limiting factor, evidenced by current growth rates of kokanee. However, if substitution or mitigation actions build a kokanee population to the size necessary to achieve an annual harvest goal of 300,000 kokanee, food production will most likely be a limiting factor resulting in reduced fish growth and perhaps survival (Cichosz et al 1999). Continued

monitoring of the zooplankton community is imperative to determine fish food availability and identify actions, which enhance zooplankton densities.

Tributary spawning and rearing habitats limit Lake Roosevelt salmonid fish production (Beckman et al. 1985). Furthermore, natural recruitment of kokanee in Lake Roosevelt is limited, since annual drawdowns expose shoreline redds (Stober et al. 1981). As a result, hatchery and net pen production are used to overcome the production limitation.

Limiting factors directly related to hatchery operational strategies and success in terms of survival to the creel and adult return include early maturity (precocity) and skewed sexual ratios (McLellan et al. 2003). In 2002, hatchery operations have employed thermal manipulation strategies and use of alternative protein source feeds to lower the incidence of early maturing fish.

30.10.3 Curlew Lake

The stocking of silver trout in the late 1940s and kokanee salmon in the 1970s failed to produce a self-reproducing population; currently these species are absent from the Lake. The failure of these stocking efforts was most likely due to the lack of perennial tributaries and the severe stratification of the lake during summer months, which rendered and continues to render most of the lake volume anoxic. In addition, the only perennial tributary to Curlew Lake, Trout Creek, has an intermittently impassable culvert, which is positioned a short distance upstream from its mouth. Low flows in the fall season prevent fish from passing through the culvert, and spring freshets are too strong for fish to navigate through the culvert in most years.

30.10.4 Kettle and Colville Rivers

Timber production, grazing, road construction, water diversions, and recreational uses have all led to a decrease in habitat quality in the Kettle and Colville rivers. These activities have increased sediment loads, altered seasonal water regimes and destabilized streambanks, resulting in simplification of stream habitats and an overall decrease in water quality. These impacts, combined with stocking of exotic species, have resulted in significant reduction in the ranges of redband and cutthroat trout. While it is uncertain if bull trout were historically present in the Kettle River above Cascade Falls or in the Colville River above Meyers Falls, although their have been bull trout sightings within the last fifteen years in the Kettle River.

For a more detailed analysis of specific limiting habitat factors in the Upper Columbia Subbasin see sections on focal species where limiting factors based on QHA results and key findings for each focal species are discussed.

30.10.5 Description of Historic Factors Leading to Decline of Focal Species

Hydroelectric operations at Chief Joseph and Grand Coulee dams block anadromous and resident fish migration. This has resulted in the reduction of the native salmonid species assemblage by 64 percent (Scholz et al. 1985). Loss of salmon and steelhead and the change from a fluvial to a lacustrine environment negatively impacted the ecosystem and forever changed the ecological structure of the area above the dam. The current fish

assemblage is a result of anthropogenic actions that have created an unbalanced, ever shifting, perturbated lotic/lentic hybrid reservoir-based ecosystem. Anadromous fish have been absent in this Subbasin for more than 60 years and has allowed people to forget that anadromous fish dominated the native fish assemblage and were a keystone component to the ecosystem (Lichatowich 1999; Willson and Halupka 1995; Cederholm et al. 1989; Kline et al. 1990; and Mills et al. 1993).

Resident fish species were also impacted through habitat alteration (inundation), lost productivity (absence of marine-derived nutrients), habitat degradation relating to land-use practices (hydroelectric development, agriculture, grazing, logging, and municipal development), and altered aquatic communities (exotic introductions) attributable to Euro-American settlement. The current resident fish assemblage has little resemblance to the pre-impoundment assemblage. Currently, bull trout, westslope cutthroat trout, and redband trout are rarely encountered in Lake Roosevelt (Cichosz et al. 1999; Underwood and Shields 1995). Moreover, tributaries of Lake Roosevelt contain limited populations of adfluvial stocks of salmonids. As a result, a majority of the current salmonid assemblage consists of nonnative coastal rainbow trout, brook trout, and brown trout. The non-salmonid community and abundance structure has changed from an assemblage/abundance of mostly white sturgeon, lamprey, and burbot to that of walleye and smallmouth bass. In addition, lake whitefish have displaced mountain whitefish populations (Cichosz et al. 1999). Since impoundment, white sturgeon populations have declined to unhealthy levels, with the only known spawning location just below the confluence with the Pend Oreille River in British Columbia.

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31 Upper Columbia Subbasin Inventory of Existing Programs – Aquatic[1]

31.1 Current Management Directions

The State of Washington Department of Fish and Wildlife (WDFW), Colville Confederated Tribes (CCT), and the Spokane Tribe of Indians (STOI) are the primary resource managers in the Upper Columbia Subbasin. These three management agencies with fisheries management responsibility within the Subbasin have initiated numerous projects through the Northwest Power and Conservation Council's (Council) Fish and Wildlife Program as partial substitution for the loss of anadromous fish due to the federal hydropower system utilizing resident fish (resident fish substitution).

State and Federal agencies and Tribal governments that have management authority over fish and wildlife and their habitats in the Upper Columbia Subbasin include the U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service (USFS), Washington Department of Fish and Wildlife (WDFW), Colville Confederated Tribes (CCT), and the Spokane Tribe of Indians (STOI). Other agencies, including, but not limited to, the Environmental Protection Agency (EPA), the Natural Resources Conservation Service (NRCS), and the Washington State Department of Ecology (WDOE) are involved in programs that affect the land or water that provide habitat for fish and wildlife. A complete list of state, federal, and Tribal entities that are involved in management of fish and wildlife or their habitats is included in section 2.4.1, along with a description of the agency's management direction.

Native species recovery is a priority in areas where such efforts are feasible; however, providing subsistence and recreational fisheries in severely altered habitats may be accomplished using nonnative species/stocks. It must be recognized that the extirpation of anadromous fish from the Subbasin has severely limited the fishery. Until anadromous fish can feasibly be recovered in the Subbasin, on-site and off-site resident fish projects will be used as partial substitution for anadromous losses.

The following section describes the local government entities that are involved in natural resources management in the Upper Columbia Subbasin

31.1.1 Local Government

31.1.1.1 Ferry Conservation District (FCD) Current Management Strategies

FCD is involved in several partnership efforts from individuals and agencies, to school districts and tribes. As a political subdivision of Washington State government (under the umbrella of the Washington State Conservation Commission), the FCD serves the public in a manner that best provides for the interest and management of natural resources and environmental protection. As the last non-regulatory entity left in the State of Washington, it provides a service to individuals, associations, local government, etc. in a neutral manner that promotes being proactive in the planning and management for natural resources.

Though only receiving approximately $9,700 a year from the Conservation Commission for basic funding, FCD has sought out and applied moneys to the planning and implementation that improves and enhances water quality, as well as fish and wildlife-habitat. FCD was the first in the northwest to use DNA microbial source sampling as a tool to identify problems and problem areas, to start focusing project dollars where the money can do the most good and return the most benefit-to-dollar ratio. The shade and water temperature studies have produced valuable data that are now being used by the USFS and WDOE to implement TMDL programs throughout northeastern Washington. The District is involved in the partnership efforts with WDOE TMDL projects in three different counties so far, and is contributing equipment and manpower towards these efforts at no charge.

FCD currently is receiving grants for projects (that were not recorded in the IMP reports because they are currently being implemented) to include: Implementation Grants from Washington Conservation Commission, WDOE, National Fish and Wildlife Foundation, EPA, and the USFS. Much of the implementation dollars are being used to finish projects individuals and agencies have prioritized, but didn't have the finances to start or complete. The most recent grant from WDOE is the Headwaters of the San Poil (HOSP). This grant serves to implement projects for landowners, the USFS, Ferry County, State Department of Transportation, and the CCT on projects on the headwaters and main body of the San Poil River.

Many of the primary priorities are to reduce the problems that caused water bodies to get listed on the EPA 303(d) list in the first place. With the focus on improving water quality standards, the District implements Best Management Practices (BMPs) that will also create, restore, or enhance fish and wildlife-habitat. Projects being implemented are primarily for the improvement of fish and wildlife-habitat. FCD has attracted partners from the Audubon Society and the Bonneville Environmental Foundation who have taken a serious interest in the management FCD is involved in for habitat, dam removal projects, etc., as well as the use of FCD lands for fish and wildlife education.

Next year, FCD will be applying for two more Centennial Clean Water Funded Grants from DOE. One is to focus on fecal coliform problems and solutions (and other water quality standards) with implementation projects throughout Ferry County. The other is to team with the Forest Service, who has received funding to do an environmental analysis on the proposed action of removing a dam. FCD has been successful in receiving the maximum funded grants from WDOE (over $300,000 total budgets), and want to continue to match these efforts towards the efforts of others to improve and protect the environment. Funding efforts will continue for other dollars through various means for the same kinds of resource implementation.

FCD participates in many local and regional planning efforts. The District has also been quite involved in local Water Resource Inventory Area (WRIA) processes and plans on pursuing the Lead Entity on the San Poil WRIA (52). The District's involvement in these planning processes, attendance at local association meetings, starting watershed planning

groups, and other stakeholder functions, will keep will keep the District aware of the current resource management concerns.

FCD staff is also involved on State Natural Resource committees and associations to assist others with natural resource concerns, and to secure additional funding for the implementation of those solutions. In addition, FCD serves on a three-county Local Working Group to assist the NRCS in the selection and implementation of the Environmental Quality and Incentives Program (EQIP) to allocate funding from the U.S. Farm Bill.

As FCD teams with many agencies, often as the liaison between all the partners, it plans to have the same kinds of past success to help landowners and agencies become and/or stay proactive in their efforts to improve and protect their resources. The primary function is providing cost-share incentives for projects, and educating the general public about the need for natural resource protection and environmental enhancement. This is a part of the management strategies for the future.

31.1.1.2 Lincoln County Conservation District (LCCD)

Mission Statement

The philosophy of the District is that all natural resources are integrated. Their mission is to protect and enhance Soil, Water, Air, Plants, Animals, and Humans (SWAPAH) of Lincoln County through an integrated approach and educate the general public about the responsible use of SWAPAH, through economically viable and socially acceptable programs. Their intention is to promote the responsible use, increase knowledge and research of our natural resource base.

Current Management Strategies

LCCD's current management strategies can be summarized from excerpts of the District's updated Long Range Plan. The goals and objectives include:

<u>Water Quality</u>

- Address water quality concerns in streams and lakes in Lincoln County
- Address groundwater issues in Lincoln County
- Implement restoration projects that would improve water quality
- Work with NRCS, WDFW, WDOE and Lincoln County to address water quality complaints

<u>Wildlife</u>

- Establish wildlife habitat and enhance forest/wetland resources through NRCS programs that include: Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), and Wildlife Habitat Incentives Program (WHIP)

Education / Information / Communication

- Increase public awareness of District activities

- Provide educational conservation information to the public through newsletters, public meetings, newspaper articles, etc.

District Operations and Management

- Maintain an active and effective LCCD board
- Promote district programs and activities
- Insure adequate funding for LCCD operations

In the last five years, LCCD has been involved in a minimal number of projects in Spokane and Upper Columbia subbasins. Many landowners in these subbasins have taken advantage of NRCS programs that include CRP, EQIP, and WHIP. Currently, funding sources are focused on finding solutions to improve water quality in the Upper Crab/Wilson Creek Watershed WRIA #43.

31.2 Existing and Imminent Protections

Currently, bull trout are the only federally-listed fish species within the Upper Columbia Subbasin. However, it is presumed the distribution of bull trout are not widespread within the Subbasin. Habitat within the Upper Columbia Subbasin has not been determined to be within the critical habitat area as outlined by the USFWS. Fish species that are potential candidates for ESA listing may include redband trout and white sturgeon.

31.3 Inventory of Recent Restoration and Conservation Projects

Numerous projects through the Northwest Power and Conservation Council's Fish and Wildlife Program have been initiated. These projects were undertaken as partial substitution for the loss of anadromous fish due to the creation of the federal hydropower system utilizing resident fish (resident fish substitution). Projects designed to enhance the resident fishery (both native and nonnative) in the "blocked area" include:

- Habitat/passage improvements (Lake Roosevelt Rainbow Trout Habitat/Passage Improvement project, #9001800)
- Stock assessment activities (Habitat/Passage Improvement project, #9001800, Chief Joseph Kokanee Enhancement Project, #9501100, Lake Roosevelt Fisheries Evaluation Program, #944300 and the Lake Roosevelt Sturgeon Recovery Project, #199502700)
- Artificial production enhancement activities (Colville Tribal Fish Hatchery, #8503800, Spokane Tribal Hatchery, #9104600, Sherman Creek Hatchery, #9104700 and Lake Roosevelt Rainbow Trout Net Pens, #9500900)
- Lake Roosevelt Emergency Fish Restoration Project

Other fish management efforts include the WDFW Colville Hatchery. Hatchery production programs are being monitored to evaluate their contribution to existing fisheries in the Subbasin. Habitat improvement projects are currently being monitored/evaluated for effectiveness, while existing habitat and fish population evaluations are proceeding throughout the basin. In addition, the WDFW is constructing a

native redband rainbow trout broodstock trapping facility located 16 miles north of Colville, WA. This facility will aid in native fish restoration within the subbasin.

The following describes the projects listed above in more detail.

31.3.1 BPA Funded Projects

Colville Tribal Hatchery (#8503800)

Operations began at the hatchery in 1990 and have continued to the present time. Originally the project was production goal oriented (1990-1994). However, in 1995 more fisheries-related goals and objectives were developed for the program to assess the program impact on subsistence and recreational fisheries (Truscott 1995). Objectives include short-term (annual production objectives and administrative objectives) and long-term (for example, average creel size fish, catch per unit efforts, average fish condition factor in creel, increases in natural production fishery component, maintenance and development of free-ranging brood stock sources, monitoring and evaluation and development of comprehensive fishery management plans) fishery-related objectives. Reports and technical papers developed during this period include annual operating plans and reports.

Fourteen lakes and streams of the Colville Reservation, included in the Lake Roosevelt Subbasin, are stocked annually with fish originating in the Colville Tribal Hatchery (Truscott 1997). Stocking density from the Colville Tribal Hatchery in Reservation waters of the Lake Roosevelt subbasin averages over 812,000 fish with an average weight of 38,298 pounds (Truscott 1997). This stocking program has been successful at providing subsistence and recreational opportunities. For example, creel surveys on North and South Twin Lakes between 1991 and 1997 estimate that anglers harvested rainbow trout at a rate of 0.446 fish per angler hour and maintained an average fish condition factor of 132×10^{-7} (Truscott 1997). During the same period, anglers harvested brook trout at a 0.11 fish per angler hour rate, while maintaining an average fish condition factor of
129.6×10^{-7}(Truscott 1997). However, the brook trout fishery in the two lakes was conducted in the spring and fall months in the littoral zone of the lakes. The creel survey was conducted from April through October, which was likely the reason for the low catch rate for brook trout. A monthly evaluation of the catch would likely reveal a more accurate description of the fishery.

Spokane Tribal Hatchery (#9104600)

The Spokane Tribal Hatchery (STH) (located at Galbraith Springs) project originated from the Northwest Power Planning Council (NPPC) 1987 Columbia Basin Fish and Wildlife Program. The goal of this project is to aid in the restoration and enhancement of the Lake Roosevelt and Banks Lake fisheries adversely affected by the construction and operation of Grand Coulee Dam. The objective is to produce kokanee salmon and rainbow trout for release into Lake Roosevelt for maintaining a viable fishery. The goal and objective of this project adheres to the Council's Resident Fish Substitution Policy and specifically to the biological objectives addressed in the Council's Columbia River

Basin Fish and Wildlife Program to mitigate for hydropower related fish losses in the blocked area above Chief Joseph/Grand Coulee Dams.

The STH (managed by the STOI) is one component of 4 artificial production *projects* operated complementary of one another as part of a *program* to restore and enhance the Grand Coulee impoundment fisheries (Lake Roosevelt and Banks Lake). The other artificial production components include the Sherman Creek Hatchery (SCH), Ford Trout Hatchery and the Lake Roosevelt Kokanee and Rainbow Trout Net Pen Projects. The Spokane Tribe operates the Spokane Tribal Hatchery, the WDFW operates the Sherman Creek Hatchery, Ford Trout Hatchery and the Kokanee Net Pen Project and the Lake Roosevelt Development Association operates the Rainbow Trout Net Pen Project.

Each project has its own production goal to collectively produce up to 1,000,000 kokanee yearlings, 1.4 million kokanee fry/fingerlings and 500,000 rainbow trout yearlings for annual stocking into Lake Roosevelt and Banks Lake. Fishery managers from the WDFW, STOI and CCT comprise the Lake Roosevelt Hatcheries Coordination Team responsible for directing hatchery and net pen rearing operations. Performance and evaluation of hatchery and net pen reared fish released into the project area and the impact on the biota is monitored and evaluated by the Lake Roosevelt and Banks Lake Fisheries Evaluation Programs.

Sherman Creek Hatchery (#9104700)

SCH's (managed by WDFW) primary objective is the restoration and enhancement of the recreational and subsistence fishery in Lake Roosevelt and Banks Lake. SCH was designed to rear 1.7 million kokanee fry for acclimation and imprinting during the spring and early summer. Additionally, it was designed to trap all available returning adult kokanee during the fall for broodstock operations and evaluations. Since the start of this program, the operations on Lake Roosevelt have been modified to better achieve program goals.

The WDFW, STOI and the CCT form the interagency Lake Roosevelt Hatcheries Coordination Team (LRHCT), which sets goals and objectives for both SCH and the Spokane Tribal Hatchery, and serves to coordinate enhancement efforts on Lake Roosevelt and Banks Lake.

The primary changes have been to replace the kokanee fingerling program with a yearling (post smolt) program of up to 1,000,000 fish. To handle the increased production, twenty net pens were constructed and are currently operated. The second significant change was to rear up to 300,000 rainbow trout fingerling at SCH from July through October, for stocking into the volunteer net pens. This enables the STH to rear additional kokanee to further the enhancement efforts on Lake Roosevelt.

Current objectives include increased use of native/indigenous stocks where available for propagation into Upper Columbia Subbasin waters.

The Lake Roosevelt Fisheries Evaluation Program (LRFEP) is responsible for monitoring and evaluation on the Lake Roosevelt Projects. From 1988 to 1998, the principal sport fishery on Lake Roosevelt has shifted from walleye to include ainbow trout and kokanee salmon (Underwood et al. 1997; Tilson and Scholz 1997). The angler use, harvest rates for rainbow and kokanee, and the economic value of the fishery have increased substantially during this ten-year period. The investigations on the lake also suggest that the hatchery and net pen programs have enhanced the Lake Roosevelt fishery while not negatively impacting wild and native stocks within the lake.

Lake Roosevelt Trout Net Pen Project (#9500900)

The Lake Roosevelt Net Pen Project is a grass roots, community based, effort to enhance rainbow trout harvest opportunities. This project began in the 1980s with local anglers looking for a method to enhance the Lake Roosevelt fishery. In 1996, BPA provided a coordinator to assure this program continued. Today the project produces approximately 500,000 rainbow trout and 250,000 kokanee salmon for the Lake Roosevelt sport and subsistence fishery. The STH rears the rainbow trout from eggs in November to fry in September. The hatchery then transfers the fish to the net pens in September, where they are reared to catchable size by June. The rainbow trout are released ideally in June, but in years of deep drawdown, physical limitations require earlier releases. The net pen program produces the most successful fishery in the lake. Over 95 percent of all rainbow trout captured in the lake are from the net pens.

Chief Joseph Kokanee Enhancement Project (#9501100)

The goal of the Chief Joseph Kokanee Enhancement Project is to protect and enhance the natural production of kokanee stocks above Chief Joseph and Grand Coulee dams. Further goals are to provide successful subsistence and recreational fisheries and a broodstock source for artificial production in Lake Roosevelt.

Field activities began in the fall of 1995 and continue today. Activities include: (1) Ongoing annual monitoring of adult spawner escapement, (2) Continued research into genetic profiles of all known kokanee stocks, (3) Fine scale fish behavior study at Grand Coulee Dam's third power plant using multi/split beam acoustic assessment of strobe light efficacy in conjunction with sonic tags and underwater hydrophones. Small-scale assessment of Grand Coulee Pumping/generation station entrainment into Banks Lake, (4) Conduct kokanee reintroduction (300,000) into Big Sheep Creek using Meadow Creek, B.C. stocks, (5) spawning escapement monitoring and enumeration of adult kokanee present in Lake Roosevelt and Rufus Woods Reservoir tributaries (San Poil River, Big Sheep Creek, Deep Creek, Onion Creek, Ora-Pa-Ken Creek and Nespelem River respectively), (6) collection of genetic material from adult tributary spawning populations in the aforementioned streams and free-ranging kokanee in Lake Roosevelt kokanee, (7) collection of kokanee "swim-up" from redds and monitoring fry emigration from the San Poil River to Lake Roosevelt.

Critical project accomplishments include the determination that a minimum of seven different kokanee stocks exist, all of which may be inhabiting lake Roosevelt, with one other stock currently being examined. Entrainment at Grand Coulee Dam was

determined to be considerable (LeCaire 1999). Over forty-two month acoustic assessment showed 1,655,000 fish targets entrained through Grand Coulee Dam; eighty five percent of the entrainment was determined to take place at the third power plant during peaking operations (Sullivan 1999). Naturally producing kokanee are comprising a large portion of the existing fishery, however naturally producing tributary stocks seem to be in jeopardy. Strobe light efficacy testing reveals that the use as a deterrent may be more effective during night, however stronger results are seen when higher flows are present at the forebay during power-peaking operations. The project is beginning a reintroduction effort using an indigenous wild origin kokanee stock (Meadow Creek, B.C.). Additionally, important data have and continue to be collected relating entrainment characteristics to project operations (flood control draft, power draft, power peaking, spring and summer flow augmentation, temperature profile mapping, current profiles, plankton populations and associated forebay conditions.

Lake Roosevelt Monitoring Program (#944300)

Project Description:

This program has two primary goals. The first is to monitor and evaluate the performance of fish released into Lake Roosevelt by the STH and SCH. The second goal is to develop a fisheries management plan for Lake Roosevelt that prescribes mitigation/substitution actions and hydro-operations that will maximize ecosystem diversity, complexity, and sustainability. In order to develop an achievable fisheries management plan, a better understanding of this dynamic reservoir ecosystem is required. The Lake Roosevelt Ecology Model is being developed to improve knowledge of physical and chemical limnology, hydrology, and biological production of the reservoir to better predict the effects of single actions on the ecosystem and fishery. Objectives include: development of a Lake Roosevelt Fishery Management Plan with hydro-operation recommendations; refined analyses of trophic interactions and effects of various parameters on trophic levels; maintenance of databases in order to validate, refine, and maintain the Lake Roosevelt Ecology Model; validation and refinement of the Lake Roosevelt Ecology Model; monitoring and evaluation of impacts of hatchery origin fish on native species and the lower trophic levels of Lake Roosevelt; monitoring and evaluation of wild fish and different hatchery stocks of kokanee salmon and rainbow trout performance in Lake Roosevelt.

Associated Monitoring:

This program is the monitoring and evaluation tool for the SCH and STH.

Accomplishments:

Accomplishments include identification of changes in the fish assemblage and community structure of resident fish species, identification of diet preferences and dietary overlaps that could lead to competition (inter- and intraspecific), evaluation of various hatchery stocks performance through tagging studies, tracking of the economic value of the Lake Roosevelt fishery through fishing pressure and harvest in Lake Roosevelt as identified by a reservoir-wide creel study, and establishing a limnological data set for the Lake Roosevelt Ecology Model.

Lake Roosevelt Sturgeon Recovery Project #1995-027-00

Project Description:

Without effective intervention, white sturgeon population appears headed for extinction in the Columbia River upstream from Grand Coulee Dam. Natural recruitment has failed and the population now consists of an aging cohort of adults whose numbers are steadily dwindling. Concern has arisen over the declining status of native sturgeon populations throughout the Columbia River Basin. White sturgeon populations above Grand Coulee Dam were closed to harvest in 1996, and closed to sturgeon fishing in both Lake Rufus Woods and Lake Roosevelt in 2002, due to increasing concerns over the apparent declining status of the population. Mitigative and/or restorative efforts have become necessary to maintain this particular white sturgeon stock, which possesses genetic traits different from other Columbia River stocks (Setter and Brannon 1992). Similar genetic differences and recruitment failure for the Kootenai River white sturgeon stock led to its listing as an endangered species in 1994. In 1998, the WDFW and the Spokane Tribe of Indians sampled an aged white sturgeon population above Grand Coulee Dam and confirmed that virtually no recruitment has occurred during the past 20 to 25 years.

The Upper Columbia River White Sturgeon Recovery Plan, initiated in Canada and completed with involvement by U.S. parties, identifies the lack of information on the actual numbers and limiting factors of white sturgeon in U.S. waters of the transboundary reach between Lake Roosevelt and Keenleyside Dam as a critical uncertainty. The overall goal is to prevent the extinction of upper Columbia River white sturgeon and to recover the population to a level that allows for harvest.

Objectives of the program include development of recovery plans for white sturgeon in the Upper Columbia River in coordination with U.S., Canadian, Federal, State, and Tribal parties; to determine abundance, distribution, and population productivity of adult white sturgeon, whether one or multiple white sturgeon populations exist; to conduct a limiting factors analysis of white sturgeon in the Upper Columbia River between Grand Coulee Dam and the international border; to determine whether suitable white sturgeon spawning habitat and conditions exist between Grand Coulee Dam and the international border; to determine abundance, distribution, and relative year class strength of juvenile white sturgeon between Grand Coulee Dam and the international border; and to evaluate the feasibility of prospective recovery measures for white sturgeon in the transboundary reach.

Associated Monitoring:

The program will do initial studies to determine current status of white sturgeon in the Upper Columbia River between Grand Coulee Dam and the international border. The program, now and in the future, will monitor implementation of recovery efforts.

Accomplishments:

During 2001-2002, this project assisted in the development of an Upper Columbia River White Sturgeon Recovery Plan that reviewed available information on sturgeon status and biology, identified objectives, strategies, and measures for sturgeon recovery, and outlined a coordinated effort on both sides of the border.

Special Notes:
Delays in contracting in 2001-2002 delayed adult sampling for an additional year, and minimized juvenile sampling in 2002. Currently, the program is fully staffed for needs in 2003-2004. Monitoring to determine current population status, and evaluation of artificial production feasibility as a conservation interim action are moving forward.

Lake Roosevelt Emergency Fish Restoration Project
Project Description:
This project was a one-time funded project by BPA to compensate for power system operations during the power emergency period. A solicitation was developed by the Colville Confederated Tribes Fish and Wildlife Department and submitted to BPA for funding.

Several factors were involved in creating the request for funding. These included safety of the volunteers that maintain the project during the cold, windy winter months. Many of the net pens were badly worn and damaged from the recent untimely drawdown period. The final concern was that the drawdown occurred during a time when high entrainment traditionally occurred. New net pen complexes were purchased that had safety walkways and handrails installed. A total of four pen complexes of four pens each were purchased and installed.

Several thousand triploid steelhead were purchased and planted at various locations within the lake. The initial lot of triploids averaged 1.84 pounds each, while the second lot averaged 2.2 pounds each. An additional lot of 100,000 were purchased, reared, and released into the lake. All of the large fish were tagged with flow tags. In addition, 10 percent of the small fish were tagged. Floy tag returns to Eastern Washington University indicated that the planted triploids supported a winter fishery in 2000 and still are making a considerable contribution to the fishery.

Associated Monitoring:
The project was a total success as evidenced by tag recovery documented by the Lake Roosevelt Monitoring Project. While no monitoring efforts were undertaken by the project, the Lake Roosevelt Monitoring Project is collecting data pertinent to the project's success. Current Lake Roosevelt monitoring efforts are still documenting the recruitment of the triploids to the creel.

Accomplishments:
- Replaced many old degraded net pens with new net pens and docks that have a safety handrail attached and a skid resistant walkway.
- Purchased needed equipment and waterproof storage boxes for fish feed.
- Contributed to a very successful winter steelhead fishery along Lake Roosevelt.
- Helped generate further positive public feelings for the Tribal and BPA funded fishery enhancement effort.
- As evidenced by the number of letters from the local business operators, the project created a windfall for local restaurants and motel owners.
- Planted 12,000 pounds of catchable triploid steelhead trout all along the reservoir

from Spring Canyon to as far north as Northport.
- Planted 100,000 fingerling trout from the spring transfers.
- The fish planted by the project are still recruiting to the creel.
- Used triploids to supplement the Lake Roosevelt fishery which is not only cost-effective but the fish seem to remain in the lake (not entraining out) over time, which may suggest that they should be used on a continuing basis. Unfortunately the project was only funded for a single year.

31.3.2 Non-BPA Funded Projects

Colville Hatchery (WDFW)

The WDFW Colville Trout Hatchery manages a locally adapted native rainbow trout broodstock currently being used to augment Lake Roosevelt tributary populations (Phalon Lake). In addition, it is providing fish to the Lake Roosevelt Net Pen Project to evaluate this stock's ability to resist entrainment at Grand Coulee Dam, while providing an enhanced recreational fishery.

Phalon Lake Native Redband Rainbow Trout Broodstock Trapping Facility (WDFW)

The WDFW has constructed a concrete vault trap with a ladder for fish attraction and entry, approximately 16 miles north of Colville, WA. The trap has an electric pump that supplies water to the trap and ladder (1-2 cfs). The facility supplies native redband trout eggs for the Lake Roosevelt net pen program funded by BPA, and other tributary augmentation programs when required. Facility operations run during April and May of each year, and possibly September and October. Operations are monitored three to four times per week during these months. The project is co-funded by Alcoa Foundation, Spokane Fly Clubs, Meyers Falls Hydro Project, and WDFW. The facility will be completed in the spring of

Graham Lake Native Trout / Remote Site Incubator Research

The project is intended to determine the practical use of remote egg incubators to establish and/or perpetuate native trout species in native habitats. Incubators were stocked with native westslope cutthroat trout eggs for three brood years, 1999, 2000, and 2001. At the same time, fall cutthroat fry and yearling cutthroat were stocked from the same brood years to evaluate the three different stocking strategies. The three groups were thermally marked each year (nine groups total) to differentiate them after capture. The last collection occurred in the summer of 2003. The 2001 and 2002 collections indicated a 3 percent and 6 percent presence in the catch, respectively, of the incubator hatched fish. These percentages are relative to the number of fish captured in those years, not the total survival of the incubator-hatched fish. Analysis will be completed and a report generated. This project was co-funded by Boise Cascade Corp, Vaagen Brothers Lumber Company, and Pend Oreille Newsprint Plant and was facilitated by Washington State Senator Bob Morton. The project is sponsored by the WDFW with collaboration from Patrick Graham and Stevens County Conservation District.

Kettle Tri-Watershed Project

Project Description:

FCD took this excellent opportunity to establish agency and private citizen cooperation to specifically improve the water quality and overall management of three watersheds in the

Kettle River WRIA (60). The establishment of such a co-management team will provide Ferry County with future contributors to water quality improvement, and education on other 303(d) listed water bodies. Therefore, the purpose of this project was to conduct water quality monitoring (including fecal coliform source tracking DNA analysis providing specific characterization of what is otherwise considered to be a non-point source) and design, adopt, and implement on-the-ground and BMPs. The intent was to remove each of these watersheds from the 303(d) list. The cooperative Kettle Tri-Watershed Management Team (KTWMT) provided guidance of all project efforts, participated in monitoring efforts, and helped implement BMPs. This project was funded by the WDOE and ended in 2002.

Associated Monitoring
FCD Staff and USFS are continuing monitoring efforts.

Accomplishments:
1. Establishment of the Kettle Tri-Watershed Management Team
2. Successful demonstration of a scientifically sound, innovative, DNA analysis methodology for determining animal species sources and their relative percentages of fecal coliform contamination of water and establishing a fecal coliform source DNA library.
3. Comprehensive characterization of overall water quality by qualitative monitoring of parameters including fecal coliform, temperature, total nitrates, total phosphorous, dissolved oxygen, pH, conductivity, turbidity and discharge flow.
4. Inventory and survey existing riparian and upland conditions and practices affecting water quality.
5. Implementation of specific BMPs and a water quality protection plan to protect and enhance these three watersheds and remove them from the 303(d) list.
6. Leveraging of grant BMP "seed" funds by active solicitation of affected agencies and citizens to contribute needed funding and resources to complete selected BMPs.

Sherman Creek Study
Project Description:
The grant was approved and funded through the Centennial Clean Water Fund. The objectives of the grant are the (a) successful demonstration of a scientifically sound method for locating reaches of stream where temperature excursions are occurring, (b) implementation of site-specific BMPs to help reduce stream temperatures in affected areas, (c) stimulation of funds from other sources for implementing BMPs required to bring Sherman Creek into compliance with State water quality standards for temperature, (d) education of local citizens about the impacts on beneficial uses of water when temperatures exceed State parameters and how this project addresses this problem, and (e) development of a successful conservation partnership with local State and federal agencies with a vested interest in the study area. The project was funded by WDOE and ended in 2002.

Associated Monitoring:
Continued monitoring occurs through a partnership effort with FCD, USDA Forest Service and WDOE

Accomplishments:
The data from this study helped several agencies understand the effects of ambient air temperature on water temperature, and created some BMPs to use as tools to correct problems associated with high water temperatures and/or know where to treat and where not. The Sherman Management and Restoration Team (SMART), a multi-agency watershed team was created through this grant and will continue to meet periodically to address problems and issues, as well as work together on the implementation of projects. The partnership with FCD, USFS, and WDOE is already working together on the State's TMDL program to implement the TMDL cleanup on Sherman Creek. The WDOE is using the results of the data found in the Sherman Creek Study to create a modeling program for all similar streams east of the Kettle Range, and implementation strategies to use in the TMDL projects throughout the Upper Columbia Subbasin.

Ferry County Kettle River Park
Project Description:
Stabilize 375 feet of Kettle River bank, to preserve and enhance the community park and swim beach. The project is sponsored by Ferry County, Washington and has numerous collaborators. This project ends in 2003.

Associated Monitoring:
Regular inspection by community volunteers; annual inspection by FCD staff.

Accomplishments:
Bank is stabilized, allowing both natural and planted native vegetation to establish and stabilize streambank. The project design serves to protect the current streambank on the Kettle River, as well as capture sediments flowing down stream and placing them along the bank. The project preserves swim beach, which is an important community asset, while improving habitat for fish and wildlife, as well as addressing water quality problems associated with sediments and dissolved oxygen.

Palmanteer Fencing Project
Project Description:
Fence 2800 feet of streambank to exclude trespass cattle. This project ended in 2001 and was sponsored by the FCD.

Associated Monitoring:
Regular inspection by landowner; annual inspection by FCD staff.

Accomplishments:
Improved riparian vegetation; improved wildlife habitat; more stable streambanks; and reduce fecal coliform problems. Projects like this are designed to target several water quality issues, such as sediment loading, dissolved oxygen, fecal coliform.

Roberta Creek Restoration
Project Description:
Re-channel and return to PFC approximately 1000 feet of stream that borders an associated wetland. This project is sponsored by the FCD and ends in 2003.

Associated Monitoring:
Regular monitoring of changes in habitat quality.

Accomplishments:
Returning stream to PFC results in better wetland recharge, improved fish and wildlife habitat, reintroduction of native species in associated plants.

Brown Kettle River Bank Stabilization

Project Description:
Provided cost-share assistance to help landowner install rock veins and weirs, and plant native vegetation that helped to stabilize riverbank and improve habitat on over one-half mile of the Kettle River. This project is funded by the FCD and ends in 2003.

Associated Monitoring:
Regular inspection by FCD staff.

Accomplishments:
Project has just been installed; therefore it is too soon to assess results.

Stevens Fencing Project

Project Description:
Construct 500 feet of rail fence in a riparian area where falling trees knocked down wire fence, allowing livestock access to stream. This project was sponsored by the FCD and ended in 2001.

Associated Monitoring:
Regular inspection by landowner. Annual inspection by FCD staff.

Accomplishments:
Rail fence stays in place, denying livestock access. Banks remain more stable, water quality is improved.

Perry Septic System

Project Description:
Provided cost-share assistance, and engineering help to enable landowner to replace a defective septic system in a home on the shore of Curlew Lake. This project was completed in 1999 and was sponsored by the FCD.

Associated Monitoring:
Annual monitoring by FCD staff

Accomplishments:
Eliminated effluent discharge into the lake.

31.4 Strategies Currently Being Implemented Through Existing Projects

All three federal land managers (BLM, USFS, and NPS) enhance wildlife populations either actively with projects or passively through land use regulations. For example, the Colville National Forest has produced an Environmental Assessment with recommendations to the Washington State Department of Transportation (WDOT) on how to limit the current impacts of the state highway to instream and riparian habitat along Sherman Creek. The proposed removal or modification of Growden Dam on Sherman Creek, which is presently a barrier to fish passage (and also a safety issue), is a current example of WSDOT and the USFS working together.

31.4.1 Limiting Factors and Strategies Currently Being Implemented

As described in section 2.4.2, a database was developed that lists the recent projects that have been implemented in the Subbasin. Each project was coded for the limiting factors that were addressed, and the strategies that were employed.

In the Upper Columbia Subbasin, 45 recent restoration and conservation projects were identified. Of the projects identified, 26 were focused on resident fish, 8 primarily benefited wildlife, and 11 benefited both fish and wildlife.

The focus of many of the recent projects in the Upper Columbia Subbasin (52 percent) has been on addressing habitat related limiting factors (Figure 31.1). Habitat quality (21 percent), water quality or quantity (17 percent), habitat quantity (14 percent) and barriers (11 percent) have all received attention in recent years. The lack information has been addressed by 14 percent of the recent projects. Disease, competition, predation, and hybridization are limiting factors that have been addressed by 11 percent of the recent projects. Indirect mitigation was addressed by 11 percent of projects.

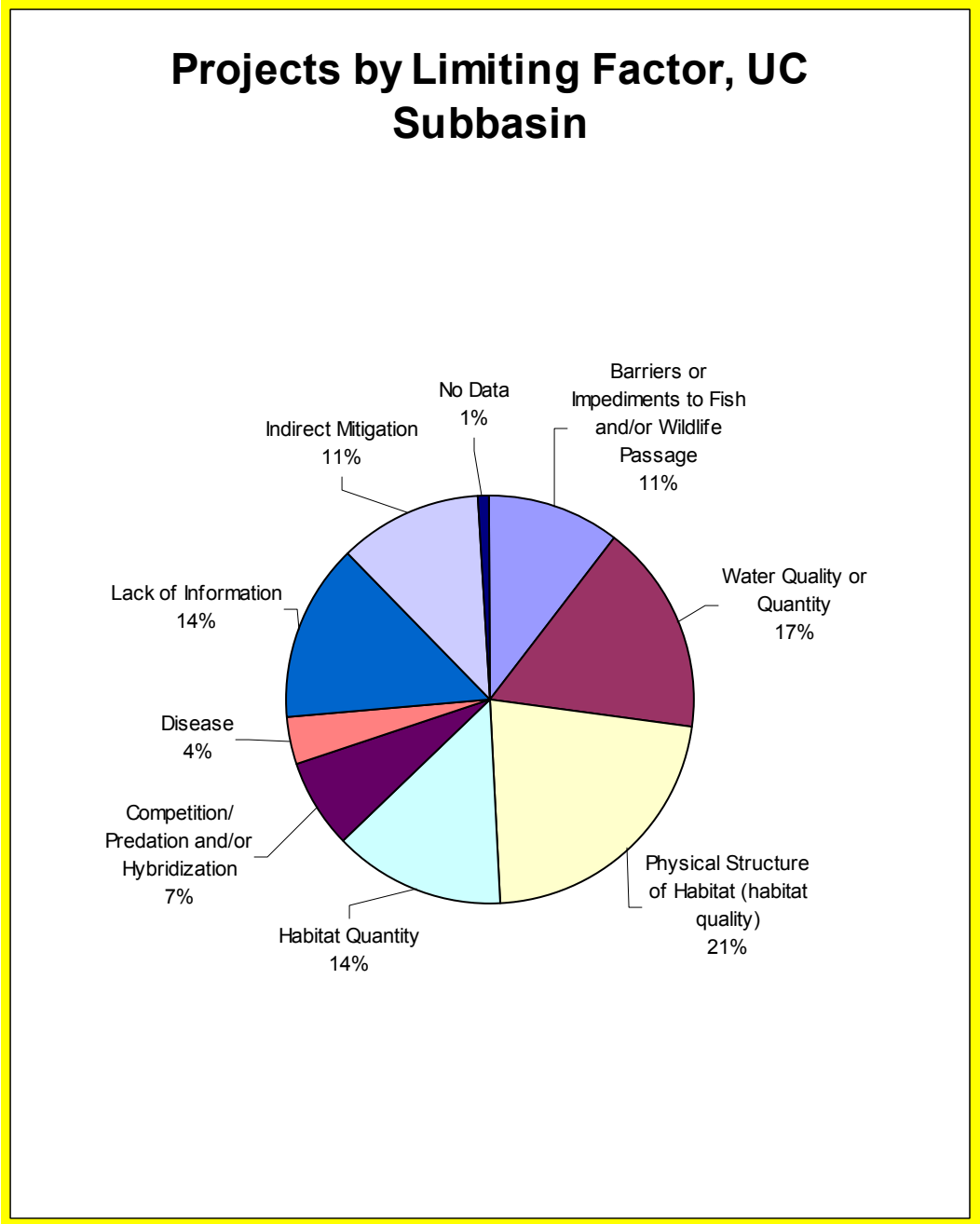

Figure 31.1 Proportion of projects in the Upper Columbia Subbasin that relate to specific limiting factors

A wide array of strategies have been employed in the Upper Columbia (Figure 31.2). The only strategy that has not been extensively employed by the projects in the database is enforcement/protection.

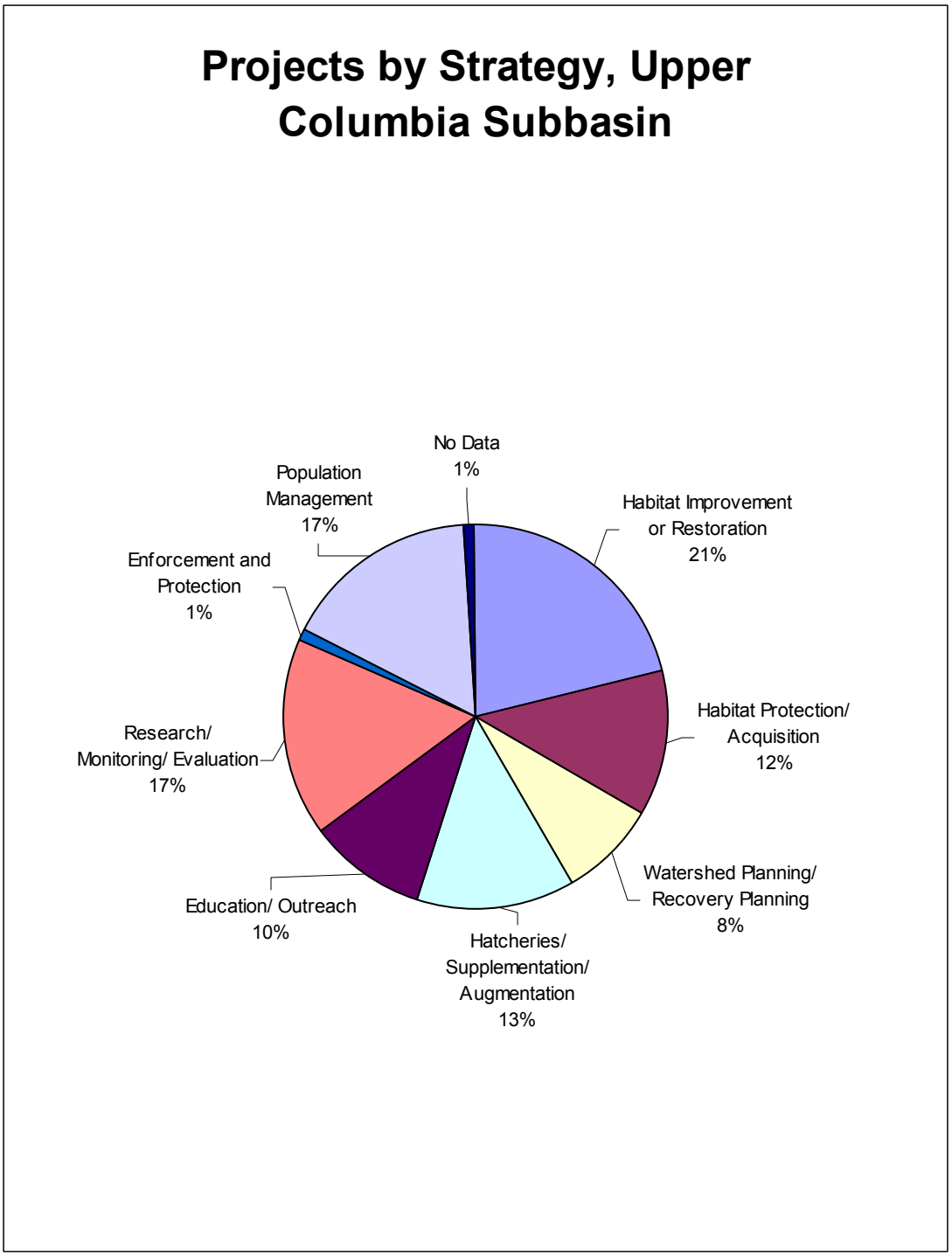

Figure 31.2. Proportion of projects in the Upper Columbia Subbasin that relate to specific strategies

31.4.2 Gaps Between Actions Taken and Actions Needed

The Technical Guide for Subbasin Planners requires that gaps between actions taken and actions needed be identified. This perspective will help determine whether ongoing activities are appropriate or should be modified and lead to new management activity considerations.

Few projects within the Upper Columbia Subbasin address restoring native fish and their habitats within tributaries to the Columbia River. Many current projects are aimed at improving the Lake Roosevelt fishery by substituting kokanee and rainbow trout for the loss of anadromous salmon. Few projects are focusing on tributary habitats where native fishes are currently or were historically present. While supplementing the Lake Roosevelt fishery is imperative in maintaining angler interest and reduce angling pressure on native stocks of fishes that are depressed, the restoration of tributary habitats may have benefits that are cost effective over the long-term. The number of current projects addressing native fish and habitats within tributary streams is lacking when compared to the number of objectives formulated by the Upper Columbia work team that are aimed at restoring native fish and their habitats within the Subbasin.

SECTION 32 – Table of Contents

32 Upper Columbia Subbasin Assessment – Terrestrial

32.1 Focal Habitats: Current Distribution, Limiting Factors, and Condition

Vegetation in the Upper Columbia Subbasin is dominated by interior mixed conifer forest, ponderosa pine forests, eastside interior grasslands, and shrub-steppe habitats. Montane mixed conifer forest, upland aspen forest, and lodgepole pine forests are present in the high elevations along with montane coniferous wetlands. Timber management is an important land use in the Subbasin on Tribal, state, federal, and private timberlands. Agriculture and grazing are other dominant land uses, particularly within the Colville River valley, on the plateaus above Lake Roosevelt, and in the extreme southern portion of the Subbasin. The largest urban areas in the Subbasin boundary include Chewelah, Colville, Kettle Falls, Davenport, and Grand Coulee.

Figure 29.4 (Section 29) shows the current distribution of wildlife-habitat types in the Upper Columbia Subbasin, as adapted from IBIS (2003). Table 32.1 presents the acres of habitats by wildlife-habitat type and by subbasin focal habitat. Five focal habitats were selected for the IMP: wetlands, riparian, steppe and shrub-steppe, upland forest, and cliff/rock outcrops. The same habitats were selected as focal habitats for the Upper Columbia Subbasin (Ad Hoc Terrestrial Resources Tech Team May 5, 2003). Focal habitats comprise about 88 percent of the basin, including upland forests (67 percent), steppe and shrub-steppe (16 percent), and wetlands and riparian habitats (2 percent, excluding open water). Developed habitats, including agricultural and urban lands, currently comprise approximately 12 percent of the Subbasin. Cliff/rock outcrop habitats are not mapped in the IBIS system.

The IBIS data is based on satellite imagery at a scale that tends to under-represent habitats that are small in size or narrow in shape. Additional information on habitats and wildlife within the Upper Columbia Subbasin is available for selected ownerships and/or jurisdictions; these sources include the WDFW, WDOE, Colville Confederated Tribes, Spokane Tribe, USFS, and USFWS. Data from these sources has been used where available to provide more specific information on habitat and wildlife species distribution within the Subbasin.

Historical vegetation data for the Subbasin is not available at a scale similar to the current condition IBIS data. Native vegetated habitats in the Subbasin have been converted to developed habitats and have also been modified through changes to vegetation type and structure. Refer to the Section 4 for a discussion of historical vs. current habitat types in the IMP and factors influencing the distribution and quality of those habitats.

Table 32.1. Current Wildlife-Habitat Types in the Upper Columbia Subbasin

Wildlife-Habitat Type	Upper Columbia Current Acres	Percent of Total
Wetlands (Focal Habitat)		
Lakes, Rivers, Ponds, and Reservoirs	88,066	3.4%
Herbaceous Wetlands	685	0.0%
Montane Coniferous Wetlands	46,188	1.8%
Riparian and Riparian Wetlands (Focal Habitat)		
Eastside (Interior) Riparian Wetlands	2,132	0.1%
Steppe and Shrub-Steppe (Focal Habitat)		
Eastside (Interior) Grasslands	281,627	10.8%
Shrub-Steppe	140,874	5.4%
Upland Forest (Focal Habitat)		
Montane Mixed Conifer Forest	28,696	1.1%
Eastside (Interior) Mixed Conifer Forest	1,300,084	49.7%
Lodgepole Pine Forest and Woodlands	17,217	0.7%
Ponderosa Pine Forest and Woodland	372,742	14.2%
Upland Aspen Forest	26,078	1.0%
Alpine and Subalpine		
Subalpine Parklands	63	0.0%
Alpine Grasslands and Shrublands	4,741	0.2%
Developed		
Agriculture, Pasture, and Mixed Environs	303,262	11.6%
Urban and Mixed Environs	6,033	0.2%
Total	**2,618,488**	**100.0%**

(*Source*: Adapted from IBIS 2003)

32.1.1 Open Water, Wetlands, and Riparian Areas

The IBIS wildlife-habitat map (Figure 29.4) is based in part on National Wetlands Inventory (NWI) mapping, but does not utilize all of the wetland categories or show the full extent of very small mapped areas. The following discussion of open water habitats is based in part on the IBIS mapping and the corresponding Table 32.1. Figure 32.1 provides a more detailed mapping of wetlands, excluding open water habitats, based on WDOE mapping (WDOE 1999) using aggregated NWI wetland types. Table 32.2 summarizes the acreages of wetlands in the Subbasin by wetland category.

32.1.1.1 Open Water

Open water habitats of natural and human origin comprise 3.4 percent of land cover in the Upper Columbia Subbasin (IBIS 2003). Lake Roosevelt reservoir is the largest waterbody in the Subbasin, extending 151 miles from Grand Coulee Dam to the Canadian border (Creveling and Renfrow 1986). Other large waterbodies include Twin Lakes, Deer Lake, Waitts Lake, and Loon Lake. Major tributary rivers include the Colville, Kettle, Spokane, and San Poil rivers.

The federal hydrosystem project at Grand Coulee results in impoundment of 151 miles of the Columbia River, 11 miles of the Kettle River, 2 miles of the Colville River, and an estimated

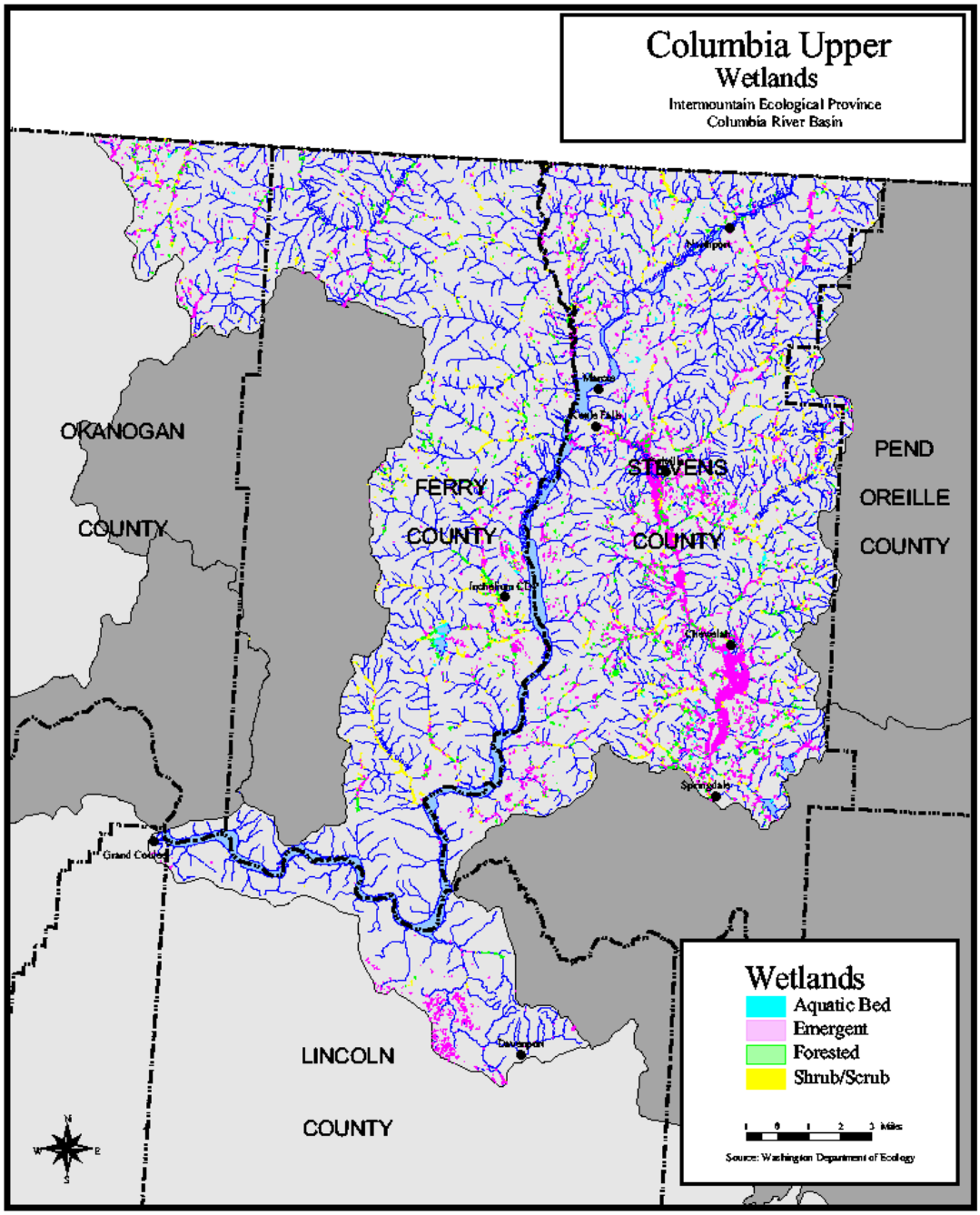

Figure 32.2

Figure 32.1 Wetland areas within the Upper Columbia Subbasin

20 to 30 miles of tributary streams. The San Poil River (12 miles) and Spokane River (28 miles) are also impounded by the dam; these areas are addressed in the San Poil Subbasin and Spokane Subbasin chapters. Timber management, agriculture, grazing, and urban/residential development also have influenced the Subbasin's waterbodies.

32.1.1.2 Wetlands and Riparian Areas

Wetlands (excluding open water habitats) comprise approximately 1.8 percent of land cover in the Upper Columbia Subbasin (Table 32.2) Wetlands are dominated by emergent herbaceous habitats (70 percent of total wetland habitat); these wetlands are scattered throughout the Subbasin, with the largest complexes in the Colville River valley. Scrub-shrub wetlands comprise about 15 percent of total wetland habitat and are located along many stream drainages, including Ninemile, Wilmont, Hall, Deer, and Cedar creeks and the Little Pend Oreille River. Forested wetlands (13 percent) are also located along many major stream drainages and adjacent to Twin Lakes, Loon Lake, and Meadow Pond.

Table 32.2. Acres of Wetlands in the Upper Columbia Subbasin by Wetland Type

Wetland Type	Acres
Emergent	33,620
Scrub/shrub	7,243
Forested	6,331
Aquatic bed	941
Total all wetland types	**48,135**

(*Source*: WDOE 1999)

Riparian vegetation along Lake Roosevelt is extremely limited, due to steep side slopes, an extensive fluctuation zone, and effects of wave action (Creveling and Renfrow 1986). Inundation of the reservoir directly affected an estimated 224 to 234 miles of riparian habitat consisting of a narrow band of discontinuous vegetation with patches of willow-dominated scrub-shrub, and occasional forested segments, with cottonwood, ponderosa pine, hawthorne, and in the northern portion, additional conifer species. Emergent wetlands, formed in small backwater pockets and at the mouths of tributaries, were also inundated by creation of Lake Roosevelt.

During the approximately three-month winter drawdown period, the water surface elevation of Lake Roosevelt is as much as 80 feet below the full pool level. The fluctuation zone is largely unvegetated, and provides little wildlife value. Wave action, combined with the fluctuating water surface levels and unstable soils, has contributed to erosion of steep banks at numerous sites on the reservoir shoreline (refer to Section 32.1.4, below).

Riparian and riparian wetlands along tributary streams of the Subbasin also have been affected by other types of water resource developments, natural and human-caused fire events, draining of agricultural and grazing lands, timber management, roads, and residential development**.** Timber harvest has affected riparian habitats through removal of overstory dominant trees, alteration of plant community structure, and increased road density (USFS 2003a).

32.1.2 Steppe and Shrub-Steppe

Interior grassland habitat is an important land cover in the Upper Columbia Subbasin, occupying 11 percent of the total area; an additional 5 percent of the Subbasin is classified as shrub-steppe. The extent of grasslands and shrub-steppe has declined from historic conditions as a result of conversion to agricultural and developed lands. Approximately 12 percent of the Subbasin is currently in agricultural uses; much of this land was converted from grassland and shrub-steppe. A secondary effect of agriculture and grazing is the introduction of nonnative noxious weeds through seed sources and via roads and equipment. Remaining grassland and shrub-steppe habitats in the Subbasin are greatly modified from historic conditions by reduction of native plant species and increase in the cover of noxious weeds.

Construction of the Grand Coulee Project resulted in loss of an estimated 14,000 acres of shrub-steppe habitat for placement of project facilities and creation of the reservoir (Creveling and Renfrow 1986).

32.1.3 Upland Forests

Upland forests in the Upper Columbia Subbasin are dominated by eastside mixed conifer forests (50 percent of total land cover) and ponderosa pine (14 percent), with lesser amounts of lodgepole pine, upland aspen, and mountain mixed conifer (approximately 1 percent each).

Historically, ponderosa pine forests were more widespread than today, dominating the southern portion of the Subbasin. Timber harvest has been a primary land use in the forested portions of the Subbasin for over 100 years. In the southern portion of the Subbasin, including a large portion of the Colville Indian Reservation, harvest of mature, overstory ponderosa pine and concurrent fire suppression, have led to a shift from a single-layered canopy of pine to stands with multiple canopies and understories more typically supporting the less fire resistant Douglas fir, grand fir, and shrubs (Underwood 2000). In the more mesic mixed conifer forests in the northern portion of the Subbasin, most old-growth and mature stands have been replaced with stands of younger seral stage and less complex structure (Williams et al. 1995). Species composition has shifted to favor more shade-tolerant, and less fire-resistant, conifer species including Douglas fir, grand fir, and subalpine fir. Fire-dependent species such as lodgepole pine have been reduced in distribution.

Construction of Grand Coulee Dam directly affected about 25,000 acres of upland forest (Creveling and Renfrow 1986). The majority of this habitat consisted of ponderosa pine savannah and forest (52 percent), mixed savannah (30 percent), and mixed forest (12 percent). Woody riparian forest and broadleaf forest comprised the remaining 6 percent.

32.1.4 Other Terrestrial Resource Limiting Factors

As noted in the Section 4, numerous specific habitat elements (called key environmental correlates, or KECs, in IBIS terminology) influence the value of wildlife-habitat types to individual wildlife species. Habitat elements may include natural attributes, such as snags, downed wood, soil types, and also include anthropogenic features such as buildings, chemical contaminants, and roads. Information on site-specific habitat elements is critical to determination of habitat suitability for wildlife. However, data is not available at a subbasin-wide level for most habitat elements. Information on selected habitat elements that have

important influences on habitat quality and wildlife use has been compiled for this assessment, including road density and salmonid nutrients lost to the IMP.

32.1.4.1 Road Density

Figure 29.6 (Section 29) shows road density, by density class, for each sixth order watershed in the Upper Columbia Subbasin. The majority of the Subbasin is ranked as high road density (1.7 to 4.7 miles of road per square mile). Several watersheds in the southernmost portion of the Subbasin, in the eastern portion, and along Lake Roosevelt are ranked as moderate road density (0.7 to 1.7 miles of road per square mile). A single watershed in the vicinity of Davenport is ranked as low road density (0.1 to 0.7 miles of road per square mile).

High road densities are indicative of human land uses and activities. In the Upper Columbia Subbasin, high road densities are associated primarily with managed timberlands. Road density values in excess of 1.5 miles per square mile are considered suboptimal for mule deer and Rocky Mountain elk summer range; values greater than 0.5 miles per square mile (mule deer) and 1.0 miles per square mile (elk) are suboptimal for the species on their winter ranges (WDFW 1991). More than half of the Upper Columbia Subbasin currently supports road density levels considered suboptimal for these game species.

32.1.4.2 Loss of Salmonid Nutrient Base

Construction and operation of the Chief Joseph and Grand Coulee dams on the Columbia River prevented salmon and other anadromous fish from returning to the Upper Columbia Subbasin, including tributary rivers and streams that once supported salmon runs. Traditional Native American anadromous fishery sites at Grand Coulee, Rickey Rapids, Kettle Falls, and along the lower Spokane River were inundated by Lake Roosevelt (Scholz et al. 1985). The loss of anadromous fish affected not only subsistence and recreational use of the resource, but also affected salmon-dependent wildlife and modified nutrient input to the overall ecosystem.

Appendix E of the 1987 Columbia Basin Fish and Wildlife Program (Council 1987) presents the results of several alternative calculations to determine the loss of salmon within the Columbia River system due to hydropower development. Based on the pre-1850 run size, with no dams in place, the number of adults at spawning grounds in reaches above Chief Joseph Dam would total 3,175,000 fish, with sockeye comprising greater than 55 percent, summer Chinook 19 percent, and fall Chinook, spring Chinook, coho, and steelhead the remaining 26 percent.

Scholz et al. (1985) compiled information on salmon and steelhead run size and harvest above Grand Coulee Dam. The results of four different techniques to estimate adult run size of the total Columbia River were summarized, showing a range of 1.2 million to 35 million fish. The authors selected the catch-based estimation technique as the most reasonable estimate of total Columbia River run size, equaling 13.1 million fish. The percentage of the total run migrating to the Upper Columbia River was estimated at 5 percent Chinook, 8 percent sockeye, 3 percent coho, and 41 percent steelhead. Using the catch-based total run size, an estimate of run size into the Upper Columbia Basin, prior to major development, was calculated at 1.1 million fish. Minimum annual catch was estimated at 644,000 fish.

The loss of salmon to focal wildlife is discussed in Section 4.5.2 (Key Wildlife Species of the Intermountain Province).

32.1.4.3 Lake Roosevelt Shoreline Erosion

The Lake Roosevelt shoreline extends approximately 530 miles, about 70 percent of which consists of easily eroded unconsolidated sediments (USBR 2000). The sediments are alternately exposed during winter reservoir drawdowns, and inundated during full pool operation. The combination of wave action and water fluctuations has contributed to slope failures of these inherently unstable soils at many locations around the reservoir. The U.S. Bureau of Reclamation (USBR) reported that 129.5 miles of reservoir shoreline had been affected by landslides and erosion (USBR 1984); monitoring and mapping of these unstable slopes continues today (USBR 2000). The majority of these sites are located within the Upper Columbia Subbasin. Figure 29.5 shows the portion of Lake Roosevelt located within the Subbasin and highlights the areas of high erosion potential along the shoreline. Analysis of a 300-foot wide band, extending upslope from elevation 1,290 feet, shows that 14 percent of the area within the band is classified as high erosion potential, while about 12 percent of the area is bedrock.

Erosion of the Lake Roosevelt shoreline has the potential to affect terrestrial resources through loss of habitats, including shrub-steppe, grasslands, wetlands, and riparian shrubs and trees. Several bald eagle nest trees located on sand bluffs along the shoreline of Lake Roosevelt are currently threatened by bank erosion (S. Zender, WDFW, personal communication, April 2, 2004). Direct loss of wildlife could occur through effects to active nesting, denning, and burrow sites. To date, site-specific assessment of the effects of shoreline erosion on terrestrial resources has not been conducted.

32.1.5 Land Ownership and Gap Status

Land ownership in the Upper Columbia Subbasin is summarized in Table 32.3 based on the Gap Analysis Program (GAP), as provided by IBIS (2003). A map of ownership categories across the province is presented in Section 4, Figure 4.3. The Upper Columbia Subbasin is dominated by private ownership (47 percent). Approximately 29 percent of the Subbasin is federally-owned; the majority of this is National Forest System lands of the Colville National Forest. A small amount of Okanogan National Forest land is located in the far northwestern corner of the Subbasin. Tribal lands of the Colville Indian Reservation and the Spokane Reservation occupy about 17 percent of the Subbasin. State lands comprise about seven percent and are distributed in numerous locations in the Subbasin.

Relative protection levels of native habitats in the Upper Columbia Subbasin are shown in Table 32.4. No lands within the Subbasin are categorized as Status 1, High Protection. Habitats protected under Status 2, Medium Protection, comprise approximately 2 percent of the total. These lands include an estimated 35,330 acres of mixed coniferous forest and about 526 acres of montane coniferous wetlands, and are located in part at the Little Pend Oreille River National Wildlife Refuge east of Colville. Approximately 34 percent of lands in the Subbasin are ranked as Status 3, Low Protection, primarily National Forest System lands which allow resource extraction. U.S. Forest Service inventoried roadless areas are included in the Low

Protection category. Lands with no specified protection total over 64 percent and include both private and tribal ownerships.

Due to the scale of the IBIS and GAP mapping, small parcels may be incorrectly categorized in this analysis. It should be noted that the 4,533-acre Grizzly Mountain wilderness area is located on the Colville Indian Reservation (Underwood 2000). No commercial timber harvest is allowed within this area. The 100,587-acre Hellsgate Game Reserve is also located on the Colville Indian Reservation; this area is managed primarily for wildlife, including bighorn sheep.

Table 32.3. Land Ownership in the Upper Columbia Subbasin by Wildlife-Habitat Type

Wildlife-Habitat Type (acres)	Federal Lands	Native American Lands	State Lands	Local Gov't. Lands	Non-Gov't. Org. Lands	Private Lands	Water	Total
Wetlands (Focal Habitat)								
Lakes, Rivers, Ponds, and Reservoirs	5,388	30,541	749	0	0	51,376	0	88,054
Herbaceous Wetlands	1	0	21	0	0	662	0	684
Montane Coniferous Wetlands	3,747	5,078	1,079	0	0	36,281	0	46,186
Riparian and Riparian Wetlands (Focal Habitat)								
Interior Riparian Wetlands	0	57	0	0	0	1,859	0	1,917
Steppe and Shrub-Steppe (Focal Habitat)								
Interior Grasslands	73,070	35,132	22,842	0	0	150,533	0	281,577
Shrub-steppe	5,431	49,659	5,133	0	0	80,548	0	140,771
Upland Forest (Focal Habitat)								
Mesic Lowland Conifer-Hardwood Forest	0	0	0	0	0	0	0	0
Montane Mixed Conifer Forest	24,044	0	0	0	0	0	0	24,044
Interior Mixed Conifer Forest	584,547	171,865	124,259	0	0	419,131	0	1,299,802
Lodgepole Pine Forest & Woodlands	7,910	0	1,129	0	0	6,438	0	15,477
Ponderosa Pine Forest & Woodlands	33,856	121,504	23,629	0	0	193,704	0	372,693
Upland Aspen Forest	5,346	2,197	0	0	0	17,506	0	25,048
Alpine and Subalpine								
Subalpine Parkland	0	0	0	0	0	0	0	0
Alpine Grasslands and Shrublands	0	0	0	0	0	0	0	0
Developed								
Agriculture, Pasture, and Mixed Environs	6,983	30,289	6,753	0	0	259,136	0	303,161
Urban and Mixed Environs	0	0	587	0	0	5,194	0	5,781
Total Acres	**750,323**	**446,324**	**186,183**	**0**	**0**	**1,222,367**	**0**	**2,605,196**

(*Source*: Adapted from IBIS 2003)

Table 32.4. GAP Status of Lands in the Upper Columbia Subbasin by Wildlife-Habitat Type

Wildlife-Habitat Type (acres)	1 - High Protection	2 - Medium Protection	3 - Low Protection	4 - No Protection	Water	Total
Wetlands (Focal Habitat)						
Lakes, Rivers, Ponds, and Reservoirs	0	2,247	1,995	83,812	0	88,054
Herbaceous Wetlands	0	0	21	663	0	684
Montane Coniferous Wetlands	0	526	4,658	41,003	0	46,186
Riparian and Riparian Wetlands (Focal Habitat)	0					
Interior Riparian Wetlands	0	6	207	1,918	0	2,131
Steppe and Shrub-Steppe (Focal Habitat)						
Interior Grasslands	0	1,921	90,942	188,714	0	281,577
Shrub-steppe	0	2,742	5,759	132,270	0	140,771
Upland Forest (Focal Habitat)						
Mesic Lowland Conifer-Hardwood Forest	0	0	0	0	0	0
Montane Mixed Conifer Forest	0	68	24,870	3,726	0	28,664
Interior Mixed Conifer Forest	0	35,330	670,216	594,256	0	1,299,802
Lodgepole Pine Forest & Woodlands	0	117	8,863	8,230	0	17,210
Ponderosa Pine Forest & Woodlands	0	7,017	46,633	319,044	0	372,693
Upland Aspen Forest	0	75	6,184	19,813	0	26,071
Alpine and Subalpine						
Subalpine Parkland	0	0	58	5	0	63
Alpine Grasslands and Shrublands	0	0	4,433	282	0	4,715
Developed						
Agriculture, Pasture, and Mixed Environs	0	2,814	13,282	287,065	0	303,161
Urban and Mixed Environs	0	55	711	5,267	0	6,033
Total Acres	**0**	**52,917**	**878,832**	**1,686,068**	**0**	**2,617,817**

(*Source*: Adapted from IBIS 2003)

GAP Status Definitions (Source: USGS 2000):
Status 1 – High Protection: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
Status 2 – Medium Protection: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
Status 3 – Low Protection: An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally-listed endangered and threatened species throughout the area.
Status 4 – No or Unknown Protection: There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

32.2 Wildlife of the Upper Columbia Subbasin

32.2.1 Wildlife Occurring in the Upper Columbia Subbasin

The Upper Columbia Subbasin provides a wide range of wildlife-habitat types dominated by interior mixed conifer and ponderosa pine forests, with montane mixed conifer and lodgepole forests in the high elevations, and small areas of montane coniferous wetlands and alpine habitats.

There are approximately 356 terrestrial vertebrate wildlife species using these habitats, many of which are important for ecological, cultural, and/or economic reasons. Table 32.5 presents the terrestrial vertebrate wildlife species occurring within the Upper Columbia Subbasin. Due to the large number of wildlife species in the Subbasin, the following discussion focuses on wildlife species that are important indicators of habitat quality, those that represent other wildlife species, and those with special management status. For further information on the broader spectrum of wildlife species in the Subbasin, refer to the Lake Roosevelt Subbasin Summary (Underwood 2001).

Table 32.5. Number of Wildlife Species (and percent of Province total) in the Upper Columbia Subbasin

	Occurring Species (Percent of Province Total)	HEP/Priority Species	HEP/Priority Species Closely Associated With Herbaceous Wetlands	HEP/Priority Species Closely Associated With Riparian Wetlands	HEP/Priority Species That Feed Upon Salmon	Occurring Species That Feed Upon Salmon
Amphibians	12 (71%)	1	1	1	0	0
Birds	231 (84%)	10	1	3	2	53
Mammals	96 (95%)	9	1	3	4	24
Reptiles	17 (94%)	0	0	0	0	2
Total	356 (86%)	20	3	7	6	79

(*Source:* IBIS 2003)

32.2.2 HEP and Priority Species of the Upper Columbia Subbasin

Subbasin planners selected a group of wildlife species to represent the focal habitats and wildlife of the Upper Columbia Subbasin. Species used in the Grand Coulee Habitat Evaluation Procedures (HEP) study (Creveling and Renfrow 1986) were selected because they were used to assess the construction and inundation losses for the federal hydrosystem project, and because they will be used in the future to evaluate mitigation for the project. Additional wildlife species were selected due to their management, cultural, and or economic values in the Subbasin; these species also represent specific focal habitats. The list of HEP and priority species for the Subbasin, as well as federal and state-listed threatened and endangered species, is presented in Table 32.6.

Table 32.6. Federal and State Endangered/Threatened, HEP, and Priority Wildlife Species of the Upper Columbia Subbasin and Degree of Association[1] with Focal Habitats During Breeding

Common & Scientific Names	Federal/ WA Listing Status [2]	HEP/ Priority Status[3]	Focal Habitats				
			Cliff/ Rock Outcrop	Wetland	Riparian	Steppe/ Shrub-Steppe	Upland Forest
American beaver *Castor canadensis*	-	P(1,2,3)	-	Close	Close	-	-
Bald eagle *Haliaeetus leucocephalus*	T / t	P(1,3,4)	-	-	General	-	General
Bighorn sheep *Ovis canadensis*	-	P(1,2,3)	General	-	-	General	-
Canada goose *Branta canadensis*	-	HEP	General	Close	-	General	-
Canada lynx *Lynx canadensis*	T / t	P(4)	-	-	-	-	Close
Columbia spotted frog *Rana luteiventris*	-	P(1)	-	Close	Close	-	-
Fisher *Martes penannti*	- / e	P(4)	-	General	-	-	Close
Golden eagle *Aquila chrysaetos*	-	P(1,3)	Close	-	General	General	General
Gray wolf *Canis lupus*	T / e	P(4)	-	-	General	General	General
Grizzly bear *Ursus arctos*	T / e	P(4)	-	-	-	-	General
Long-eared owl *Asio otus*	-	P(1)	-	-	Close	Close	Close
Mink *Mustela vison*	-	P(1,2)	-	Close	Close	-	-
Mourning dove *Zenaida macroura*	-	HEP	-	-	Close	General	General
Mule deer *Odocoileus hemionus hemionus*	-	HEP	-	General	General	General	General
Pileated woodpecker *Dryocopus pileatus*	-	P(1)	-	General	General	-	General
Ruffed grouse *Bonasa umbellatus*	-	HEP	-	General	Close	-	Close
Sage grouse *Centrocercus urophasianus*	- / t	HEP	-	-	-	Close	-
Sharp-tailed grouse *Tympanuchus phasianellus Columbianus*	- / t	HEP	-	-	-	Close	General
White-headed woodpecker *Picoides albolarvatus*	-	P(1)	-	-	General	-	Close
White-tailed deer *Odocoileus virginianus*	-	HEP	-	-	Close	General	General

(*Sources*: Upper Columbia Subbasin Work Team and IBIS 2003)

[1] **Close** = Animal dependent on the habitat for part or all of its life history requirements.
General = Animal adaptive and supported by numerous habitats.

[2] **E** = Federal Endangered. **T** = Federal Threatened. **e** = State Endangered. **t** = State Threatened.

[3] **HEP** = Species evaluated via Habitat Evaluation Procedures loss assessment for Grand Coulee Dam (Creveling and Renfrow 1986).
P = Priority species designated as important because it is **(1)** ecological indicator for habitat or other animals, **(2)** game animal, **(3)** highly culturally prized, or **(4)** special status for management. Many priority species were selected to represent one or more focal habitat types; the habitat(s) a species represents is(are) indicated by underlined degree of association (e.g., close).

The province-wide status and trends of federal and state-listed threatened and endangered species are discussed in Section 4, Terrestrial Resources in the Intermountain Province. Subbasin-level information on occurrence of federal and state-listed species is provided in this section. The occurrence of HEP and priority species in the Subbasin is also discussed briefly below. Some species were selected primarily as indicators of wildlife guilds or of a focal habitat; for many of these species detailed information on status in the Subbasin is not available.

32.2.2.1 Federal and State Threatened and Endangered Species

Bald eagle. At least 23 nesting territories are located along the length of Lake Roosevelt within the Upper Columbia Subbasin (WDFW 2003b). Another six nesting territories occur at scattered sites in the Subbasin's southeast quadrant. The total number of nesting territories in the Subbasin is the second largest in the Province, after the Pend Oreille Subbasin. There are four winter roosts along the Columbia River, and one winter foraging area along the Colville River (WDFW 2003b).

Canada lynx. Since 1979, at least 49 records of lynx sightings or tracks have been recorded for the Subbasin (WDFW 2003b). All were in the northern half, and most are near the Subbasin periphery. Most records occurred at least ten years ago, with only one record after 1996. Little Pend Oreille, The Wedge, Kettle Range, and Vulcan-Tunk areas generally above 4,000 feet elevation are lynx management zones (LMZs) located partially or completely within the Subbasin (Stinson 2001). Denning habitat appears to be lacking on the Colville Reservation and foraging habitat has not fully developed within previously harvested and burned areas (Colville Confederated Tribes 2000).

Fisher. The Subbasin's only documented recent sighting of a fisher was reported in 1989 within the Emanuel Creek drainage of the Kettle River (WDFW 2003b).

Gray wolf. Seven wolf sightings or howlings have been reported since 1991, but only one after 1992 (WDFW 2003b). All occurred along the western, northern, or eastern periphery of the northern half of the Subbasin.

Grizzly bear. Between 1983 and 2001, seven sightings of grizzly bear were reported in this Subbasin (WDFW 2003b). One was an illegal kill in 1995. All occurrences were in the northern half near the periphery of the Subbasin.

Sage grouse. There are no current records of sage grouse presence in this Subbasin (WDFW 2003b). Construction of the Grand Coulee Project resulted in a loss of 2,746 Habitat Units for sage grouse; most of this loss occurred within the Upper Columbia Subbasin.

Sharp-tailed grouse. During the period from 1979 to 1997, the WDFW (2003b) reported 22 sightings of sharp-tailed grouse in the Subbasin; 16 of the sightings were lek sightings. One grouse population was documented in the northwest corner of the Subbasin; another population was recorded south of the Columbia River at the Subbasin's southern end. Construction of the Grand Coulee Project resulted in a loss of 32,723 sharp-tailed grouse Habitat Units, largely within the Upper Columbia Subbasin.

32.2.2.2 Grand Coulee HEP Species

Canada goose. Data from the WDFW (2004a) show that the Upper Columbia Subbasin accounts for approximately three percent of the state's goose hunting harvest and two percent of its goose hunting recreation (Appendix G). That statistic combines all goose species (Canada goose, snow goose, brandt, etc.). Construction of the Grand Coulee Project resulted in a loss of 74 goose nesting islands, many of which were located in the Upper Columbia Subbasin.

Mourning dove. This Subbasin accounts for about one percent of the state total for dove hunting harvest and two percent of the total for dove hunting recreation (WDFW 2004a, as summarized in Appendix G). The Grand Coulee Project construction caused the loss of 9,316 mourning dove HUs, largely within the Upper Columbia Subbasin.

Mule deer and white-tailed deer. Both mule and white-tailed deer are native to the Subbasin. White-tailed deer populations are relatively stable, while mule deer populations in northeastern Washington are below historic levels.

The WDFW management goal is to preserve, protect, perpetuate, and manage deer and their habitat to ensure healthy, productive populations (WDFW 2003c). The population goal for white-tailed deer is to maintain relatively stable population growth. The population goal for mule deer management is an increase in populations within limitations of available mule deer habitat. The WDFW recreation management objective for deer is to maintain or increase hunting opportunity and improve hunting quality. The current general, post-hunt minimum goal for buck**:**doe ratios in Washington is greater than 15 bucks per 100 does for most populations.

An estimate of deer hunting harvest and recreation in the Upper Columbia Subbasin is presented in Table 32.7. The data for mule deer and white-tailed deer are combined in this table. Approximately nine percent of Washington's deer harvest and seven percent of its deer hunting recreation occur in this Subbasin.

Table 32.7. Mule Deer and White-tailed Deer Hunting Harvest and Recreation Within the Upper Columbia Subbasin[1]

	Harvest		Hunter-Days	
Year	Quantity	% of State Total	Quantity	% of State Total
1999	3,008	9.4	113,940	7.9
2000	4,046	10.8	79,407	8.4
2001	2,767	7.6	51,238	6.1
2002	2,736	8.1	56,147	6.7
Average	3,139	9.0	75,183	7.3

(*Source*: Appendix G)

[1] Includes all or portions of Washington Game Management Units 101, 105, 109, 121, and 133.

Construction of the Grand Coulee Project caused a loss of 27,133 mule deer Habitat Units and 21, 632 white-tailed deer Habitat Units; much of the loss occurred within the Upper Columbia Subbasin.

Ruffed grouse. Data from the WDFW shows that forest grouse hunting (ruffed grouse, blue grouse, and spruce grouse) occurs in all Washington counties of the Subbasin. The most harvest occurs in Stevens and Okanogan counties, while the least is in Lincoln County. The Upper Columbia Subbasin produces approximately 19 percent of Washington's forest grouse hunting harvest and 13 percent of its grouse hunting recreation (Table 32.8).

Table 32.8. Forest Grouse (Ruffed Grouse, Blue Grouse, and Spruce Grouse) Hunting Harvest and Recreation Within the Upper Columbia Subbasin[1]

	Harvest		Hunter-Days	
Year	Quantity	% of State Total	Quantity	% of State Total
1999	17,565	23.9	31,578	16.6
2000	29,084	19.6	53,802	13.5
2001	18,315	16.5	33,485	11.2
2002	21,741	15.7	35,035	10.6
Average	21,676	18.9	38,475	13.0

(*Source*: Appendix G)

[1] Includes portions of Chelan, Ferry, Lincoln, Okanogan, and Stevens counties.

Ruffed grouse lost 16,502 Habitat Units from construction of the Grand Coulee Project; the majority of the loss occurred within the Upper Columbia Subbasin.

Sage grouse. Refer to preceding section describing federal and state threatened and endangered species.

Sharp-tailed grouse. Refer to preceding section describing federal and state threatened and endangered species.

32.2.2.3 Other Priority Species

American beaver. Beaver are present throughout the Upper Columbia Subbasin. Trapping harvest is several times greater in Okanogan County than in Ferry or Lincoln counties. The

Subbasin harvest during 1999-2002 averaged approximately 28 beaver per year, approximately two percent of the state total (Appendix G). Harvest declined during those years, but it is not clear whether this was due to a population reduction, the passing of State Initiative 713 in 2000 (which banned the use of leg or body gripping traps), or other reasons such as a weak fur market or drop in nuisance complaints.

Bighorn sheep. Of eleven California bighorn sheep herds in Washington, two are present within the Upper Columbia Subbasin (WDFW 2003c). The Lincoln Cliffs herd borders the Columbia River in the Coulee Dam National Recreation Area northwest of Davenport. It presently numbers 95, but the desired size is 60-70 animals. The Vulcan Mountain herd is northwest of Curlew and presently numbers approximately 45 head (S. Zender, WDFW, personal communication, April 2, 2004), but the desired population is 80-110. The statewide population is currently 1,110 and the desired population size is 1,750-2,130.

WDFW management objectives include (1) improving habitat on at least 10 percent of the Vulcan Mountain herd range, (2) developing viewing opportunities for bighorn sheep herds, and (3) acquiring biological information that aids in bighorn management.

Columbia spotted frog. From 1991 to 1997, increased emphasis was placed on establishing distribution of the species and several reports of Columbia spotted frogs were recorded in the Subbasin (WDFW 2003b). All except one were in the northern half of the Subbasin and they included drainages on both sides of the Columbia River. No sightings have been reported to the Priority Habitats and Species database (WDFW 2003b) since 1997, but those records may not include information from the Colville Indian Reservation.

Golden eagle. There are approximately four nesting territories along the lower Columbia River, three territories near the upper Columbia River, and nine territories in the northwest corner of the Subbasin (WDFW 2003b). The WDFW and USFWS have begun a two-year effort to (1) increase monitoring of known golden eagle nests and (2) locate unrecorded nests in northeastern Washington (S. Zender, WDFW, personal communication, April 2, 2004).

Long-eared owl. No records of occurrence for this species in the Upper Columbia Subbasin have been submitted to the Priority Habitats and Species database (WDFW 2003b). However, Vial and Loggers (1998) list the long-eared owl as an uncommon resident in agriculture or forested lands of low to medium elevation.

Mink. Trapping reports during 1999-2002 average approximately one mink per year in the Subbasin (Appendix G). It is not clear whether this is due to a sparse population, the passing of State Initiative 713 in 2000 (which banned the use of leg or body gripping traps), or weak fur market. Prior to the trap type restrictions and increased conflict with trapping, mink were more commonly taken, especially in the low elevation streams and wetlands of the Colville Valley. In 1995, trappers reported taking four mink from northern Ferry County and sixteen from Stevens County (WDFW 1996).

Pileated woodpecker. At least one nesting sighting is known from the Upper Columbia Subbasin. It occurred in 1993 west of the Kettle River in the northwest corner of the Subbasin

(WDFW 2003b). Vial and Loggers (1998) list the pileated woodpecker as an uncommon resident in forested lands of low to timberline elevations.

White-headed woodpecker. Between 1978 and 2002, the WDFW (2003b) recorded at least six sightings in the southeast quadrant of the Subbasin, three of which were nest sites found in 1978. Vial and Loggers (1998) list the white-headed woodpecker as a rare resident in forested land of low to medium elevation, and in transitions zones of dry hillsides and open forest.

32.3 Summary of Terrestrial Resource Limiting Factors

32.3.1 Direct Effects of Federal Hydrosystem Projects

Development of the Grand Coulee Project resulted in direct loss of wildlife and wildlife-habitats in the Upper Columbia Subbasin. The habitat losses associated with construction of project facilities and inundation of project reservoirs were assessed in the Final Report on Wildlife Protection, Mitigation and Enhancement Planning for Grand Coulee Dam (Creveling and Renfrow 1986) through a Habitat Evaluation Procedures (HEP) study. The HEP evaluation species were selected based on their use of specific habitat types and structural elements, and to represent other wildlife species that use those habitats. The HEP study results are provided in terms of Habitat Units, which are units of value based on both quality and quantity of habitat. The study provides the number of habitat units to be provided in compensation for the construction losses and identifies potential mitigation areas.

Table 32.9 summarizes the loss of habitats as determined by Creveling and Renfrow. The loss of habitat value for individual wildlife species, as determined through the HEP study and expressed in Habitat Units (HUs), is summarized in Table 32.10. The current status of completed mitigation for the Grand Coulee Project is also presented; approximately 49 percent of the mitigation remains to be implemented.

Table 32.9. Acres of Habitat Types Affected by Grand Coulee Dam Project Construction and Inundation[1]

Project	Habitat Type	Acres of Habitat Inundated
Grand Coulee		
	Islands	1,000
	Riparian lands	2,000
	Shrub-steppe uplands	14,000
	Forested uplands	25,000
	Agricultural lands	15,000
	Barren lands	13,000
Total		**70,000**[1]

(*Source*: Creveling and Renfrow 1986)

[1] This figure includes the rivers' shorelines between the high and low water levels. USBR revised its figure for lands inundated by Roosevelt Reservoir to include only lands above the mean high water level. This revised figure is approximately 56,000 acres (Creveling and Renfrow 1986).

Table 32.10. Status of Mitigation for Construction and Inundation Wildlife Habitat Losses, Grand Coulee Project.[1]

Grand Coulee Project	Species	Habitat Units lost	Habitat Units acquired	Percent complete
	Mourning dove	9,316	1,001	10.7%
	Mule deer	27,133	19,056	70.2%
	Riparian forest	1,632	234	14.3%
	Riparian shrub	27	131	100.0%
	Ruffed grouse	16,502	2,908	17.6%
	Sage grouse	2,746	7,432	100.0%
	Sharp-tailed grouse	32,723	16,854	51.5%
	White-tailed deer	21,632	9,064	41.9%
	Canada goose (nesting)	74 (islands)	-	0.0%
Total all species		**111,785**	**56,680**	**50.7%**

(*Sources*: BPA 2002; WDFW 2004b, CCT 2004)

[1] Note: This table shows the total HUs lost at the Grand Coulee Project; mitigation of this loss is to be coordinated between the San Poil, Spokane, and Upper Columbia subbasins.

The majority of habitat losses associated with the Grand Coulee Project occurred within the Upper Columbia Subbasin; portions of the San Poil and Spokane subbasins (as delineated for this plan) were also affected by creation of Lake Roosevelt. Terrestrial resources mitigation required for the Grand Coulee Project in the Upper Columbia is to be coordinated between the three wildlife management jurisdictions in these three subbasins: the Colville Confederated Tribes, Spokane Tribe, and WDFW. The total number of HUs to be acquired as mitigation for the Grand Coulee Project (111,785) is presented in corresponding tables in each of the three subbasin chapters. Note that this is a single, coordinated mitigation target rather than three independent subbasin targets.

The Grand Coulee construction losses for terrestrial resources were apportioned between the three wildlife management jurisdictions in these subbasins: the Colville Tribe, Spokane Tribe, and WDFW (Creveling and Renfrow 1986). To date, WDFW has acquired the greatest number of HUs (50,678 HUs acquired, approximately 89 percent complete per WDFW 2004b); the Colville and Spokane tribes each have a substantial number of HUs remaining to be acquired.

32.3.2 Operational Effects of Federal Hydrosystem Projects

Ongoing operation of the Grand Coulee Project affects terrestrial resources of the Upper Columbia Subbasin through:

1) continued erosion of shoreline habitats along the Lake Roosevelt;
2) ongoing absence of riparian vegetation, particularly woody species, along portions of the reservoir subjected to sustained drawdowns;
3) ongoing disturbance of wildlife and habitats (for example, nest sites, amphibian breeding sites) in the fluctuation zone of the reservoir;
4) periodic disturbance of habitats and species within transmission line rights-of-way due to maintenance activities; and

5) ongoing absence of anadromous fish in the Subbasin, resulting in loss of key food item for numerous wildlife species and important nutrient input for the riverine ecosystem.

Erosion sites along Lake Roosevelt have been in inventoried and described by USBR (1984) and continue to be monitored (USBR 2000). The effects of erosion on wildlife and other terrestrial resources have not been determined. Other ongoing effects of operation of the Grand Coulee Project have not been assessed. Assessment and mitigation of the operational effects of the project are required under the Northwest Power Act, and these activities are considered a high priority by the Upper Columbia Subbasin Planning Team.

32.3.3 Secondary Effects of Federal Hydrosystem Projects and Other Limiting Factors

The federal hydropower system contributed to development in the Upper Columbia Subbasin primarily by providing an inexpensive source of power. The Upper Columbia Subbasin supports substantial agricultural land uses (12 percent of area) and high levels of timber management. Factors that currently limit terrestrial resources in the Subbasin are dominated by loss of habitat through conversion and modification, disturbance of wildlife species by humans and human activities, and interactions with nonnative plant and animal species.

32.4 Interpretation and Synthesis

The Upper Columbia Subbasin has been highly modified from historic conditions due to development and agriculture, which have converted about 12 percent of native habitat. Construction of the Grand Coulee Dam had major direct effects to the Columbia River riparian area, and tributary streams, through inundation of approximately 56,000 acres of land. Grand Coulee Dam, and the downstream Chief Joseph Dam, currently block all anadromous fish access to the Upper Columbia Subbasin and subbasins located upstream. Operation of the project continues to affect wildlife and wildlife habitats through altered hydrology; detailed assessments of operational effects have not been performed. Secondary effects of the project continue to impact wildlife of the Subbasin through human land uses and disturbance. Secondary effects of the power projects on development of the Subbasin are wide-reaching, including agriculture, grazing, timber management, and residential and urban development. Road densities are high throughout much of the Subbasin and protected lands are low in acreage.

Terrestrial resources mitigation related to the federal hydropower project at Grand Coulee is approximately 51 percent complete. Completion of the mitigation is the highest terrestrial resources priority of the Upper Columbia Subbasin Work Team, followed by assessment and mitigation of operational impacts of the hydrosystem projects.

SECTION 33 – Table of Contents

33 Upper Columbia Subbasin Inventory of Existing Programs – Terrestrial

33.1 Current Management Directions

The State of Washington Department of Fish and Wildlife (WDFW), Colville Confederated Tribes, and the Spokane Tribe of Indians are the primary resource managers in the Upper Columbia Subbasin. These three management agencies have initiated several projects through Council's Fish and Wildlife Program as mitigation for wildlife-habitat losses due to construction of Grand Coulee Dam. Other state and federal agencies, including, but not limited to, the U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service (USFS), U.S. Army Corps of Engineers (USACE), Environmental Protection Agency (EPA), the Natural Resources Conservation Service (NRCS), and the Washington Department of Ecology (WDOE) are involved in programs that affect the land or water that provide habitat for fish and wildlife. A complete list of state, federal, and Tribal entities that are involved in management of fish and wildlife or their habitats is included in section 2.4.1, along with a description of each agency's management direction.

The Natural Resources Department of the Colville Tribes has management and regulatory authority that includes, but is not limited to, the following areas: fish and wildlife management, enforcement, land use activities, water rights and adjudication, development permitting, hydraulics permitting and shoreline protection (for example, Confederated Tribes of Colville Reservation (CTCR) Shoreline Management Act). CTCR/Bureau of Indian Affairs uses the Colville Reservation Forest Plan, Integrated Resource Management Plan, Code of Federal Regulations, and others to manage land, fish, and wildlife on the Colville Reservation. It is the mission of the Fish and Wildlife Division, "To provide subsistence, cultural opportunities and economic benefits for the Tribal Membership through sustainable ecosystem management. We accept our responsibility to manage, protect, and enhance tribal natural resources and to provide multiple products and services for the tribal membership on the reservation and on accustomed and traditional lands." The current management direction is to maintain viable populations (numbers and distribution of reproductive individuals) of native and desired nonnative species of fish and wildlife, and their supporting habitats, while providing sufficient numbers to meet cultural, subsistence and recreational needs.

The Spokane Tribe of Indians manages wildlife resources on the Spokane Reservation. The Wildlife Program is directly responsible for the management of 200 acres of wildlife lands that were acquired through the BPA mitigation project in the Upper Columbia Subbasin.

33.1.1 Local Government

33.1.1.1 Ferry Conservation District (FCD)

FCD is involved in several partnership efforts from individuals and agencies, to school districts and tribes. As a political subdivision of Washington State government, under the umbrella of the Washington State Conservation Commission, FCD provides natural

resources planning and management services to individuals, associations, and local government.

Ferry County Codes
Nine codes or parts of codes may affect fish and wildlife. Most of these address urban planning/land use.

33.1.1.2 The Lincoln County Conservation District (LCCD)

LCCD's current management strategies can be summarized from excerpts of the District's updated Long Range Plan. The goals and objectives include:

Water Quality

- Address water quality concerns in streams and lakes in Lincoln County
- Address groundwater issues in Lincoln County
- Implement restoration projects that would address improve water quality
- Work with NRCS, WSFW, WDOE and Lincoln County to address water quality complaints

Wildlife

- Establish wildlife-habitat and enhance forest/wetland resources through NRCS programs that include: CRP, EQIP, and WHIP

Education/Information/Communication

- Increase public awareness of District activities
- Provide educational conservation information to the public through newsletters, public meetings, newspaper articles, etc.

District Operations and Management

- Maintain an active and effective LCCD board
- Promote district programs and activities
- Insure adequate funding for LCCD operations

In the last five years, the LCCD has been involved in a minimal number of projects in Spokane and Upper Columbia subbasins. Many landowners in these subbasins have taken advantage of NRCS programs that include CRP, EQIP, and WHIP. Currently, funding sources are focused on finding solutions to improve water quality in the Upper Crab/Wilson Creek Watershed Water Resource Inventory Area (WRIA) #43.

33.2 Existing and Imminent Protections

Refer to Section 2.4 for a description of the natural resources management agencies and organizations and their primary authorities at the federal, state, and regional levels. Many State and Federal laws and regulations protect natural resources within the IMP. Tribal governments and local governments also have regulations that protect specific areas or locations within the IMP. The following section summarizes the existing and imminent protections for federal and state threatened and endangered wildlife species known or

potentially occurring in the Upper Columbia Subbasin. Refer to the Upper Columbia Subbasin Terrestrial Resources Assessment, Section 32, for detailed description of the occurrence and status of federal and state threatened and endangered wildlife species in the subbasin.

33.2.1 Endangered Species Act

Bald Eagle

Bald eagles are currently listed as threatened under the federal Endangered Species Act. This provides protection from "take" (i.e., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect…). Bald eagles were proposed for removal from the endangered species list in 1999. That action has not been taken, in part because one prerequisite for delisting, a nationwide monitoring plan, has not yet been met. If a development project occurs on federal land or involves federal funding (i.e., nexus), an endangered species consultation may be required by the U.S. Fish and Wildlife Service.

Bald eagles are classified as threatened in Washington.

In 1984, Chapter 77.12.655 RCW was adopted by the Washington State Legislature, requiring the establishment of rules defining buffer zones around bald eagle nests and roost sites. The law states that the rules shall take into account the need for variation of the extent of the buffer zone on a case by case basis.

In 1986, the Bald Eagle Protection Rules (WAC 232-12-292) were adopted by the Washington Wildlife Commission. The rules require permitting agencies (i.e., Department of Natural Resources, counties, cities) to review the database of bald eagle nest and communal roost locations prior to issuing permits for timber harvest, clearing land, residential development, etc. If the activity is within ½ mile of an eagle nest, the permitting agency notifies WDFW, who works with the applicant to develop a Bald Eagle Management Plan (see WAC 232-12-292 (4.4)).

Deliberate harassment of eagles is prohibited by state and federal law (Chapter 77.15.130 RCW; Bald Eagle Protection Act; Endangered Species Act; and, Migratory Bird Treaty Act).

Canada Lynx

The lynx was listed as a state threatened species in Washington in 1993 and was listed as a federally threatened species under ESA in April 2000. Kettle Crest, Wedge, and Little Pend Oreille areas above 4,000 ft are designated lynx management zones (LMZs) and are located partially or completely within the Subbasin (Stinson 2001). Although a number of sightings of lynx have been recorded in the Subbasin, most of the records are over ten years old.

Legal take of lynx in Washington ceased in 1991 and consequent designation as a threatened species presently provides complete protection from hunting or trapping at both the state (Chapter 77.16.120 RCW) and federal level.

In 2000, the U.S. Forest Service signed an agreement with the USFWS to manage habitat specifically for lynx in order to minimize the impact of federal actions. Most state and private land in the northeastern Washington LMZs are covered under Lynx Management Plans that theoretically provide for maintaining suitable habitat through time. Forest practice regulations in Washington allow landowners to prepare special wildlife management plans in lieu of being subject to critical habitat rule (WAC 222-16-080). The three major non-federal landowners in Washington have WDFW approved plans in place. Each lynx management plan includes a process for monitoring the plan's effectiveness and annual or biennial reporting (Stinson 2001).

Gray Wolf
The gray wolf is listed as a federally threatened species under the ESA and is classified as endangered in Washington State. The Upper Columbia Subbasin is not located within a designated gray wolf recovery area.

In Washington, protection of gray wolf from hunting, possession, or control is provided under Chapter 77.16.120 RCW. Washington further charges those convicted of illegal take of state endangered species with a $2,000 reimbursement for each animal taken or possessed (Chapter 77.21.070 RCW).

Grizzly Bear
The grizzly bear listed as a threatened species under ESA and as an endangered species in the state of Washington. The Subbasin does not include any lands within designated grizzly bear recovery areas.

Protection of grizzly bear in Washington from hunting, possession, or control is provided under Chapter 77.16.120 RCW. Washington further charges those convicted of illegal take of state endangered species with a $2,000 reimbursement for each animal taken or possessed (Chapter 77.21.070 RCW).

Fisher
The fisher is will become a candidate for federal listing under the ESA in the near future (USFWS 2004). Fisher is a state endangered species in Washington. The species is very rare and possibly extirpated in the Columbia River and Okanogan eco-regions.

In Washington, fisher is managed based on the findings of the WDFW status report (Lewis and Stinson 1998). Protection of fisher in Washington from hunting, possession, or control is provided under Chapter 77.16.120 RCW. Washington further charges those convicted of illegal take of state endangered species with a $2,000 reimbursement for each animal taken or possessed (Chapter 77.21.070 RCW).

American White Pelican
The American white pelican is listed as an endangered species in Washington. Protection of American white pelican in Washington from hunting, possession, or control is provided under Chapter 77.16.120 RCW. Washington further charges those convicted of

illegal take of an American white pelican with a $2,000 reimbursement for each animal taken or possessed (Chapter 77.21.070 RCW).

Northern Leopard Frog
The northern leopard frog is classified as an endangered species in Washington. Protection of northern leopard frog in Washington from hunting, possession, or control is provided under Chapter 77.16.120 RCW. Washington further charges those convicted of illegal take of northern leopard frog with a $2,000 reimbursement for each animal taken or possessed (Chapter 77.21.070 RCW).

Sage Grouse
The sage grouse is classified as a threatened species in Washington. Sage grouse has been extirpated from the Subbasin due to habitat loss and modification.

Protection of sage grouse in Washington from hunting, possession, or control is provided under Chapter 77.16.120 RCW. Washington further charges those convicted of illegal take of sage grouse with a $2,000 reimbursement for each animal taken or possessed (Chapter 77.21.070 RCW).

Sharp-tailed Grouse
The Columbian sharp-tailed grouse is classified as a threatened species in Washington. At least two sharp-tailed grouse populations are currently known in the Subbasin (WDFW 2003b).

Protection of sharp-tailed grouse in Washington from hunting, possession, or control is provided under Chapter 77.16.120 RCW. Washington further charges those convicted of illegal take of sharp-tailed grouse with a $2,000 reimbursement for each animal taken or possessed (Chapter 77.21.070 RCW).

33.3 Inventory of Recent Restoration and Conservation Projects

Refer to Section 2.4, Inventory of Projects in the Intermountain Province, for description of projects involving more than one subbasin. Major Grand Coulee Dam wildlife mitigation projects are located and managed in more than one subbasin. Below is a summary of some BPA and non-BPA funded projects identified within the Subbasin. Projects that are relevant to both terrestrial and aquatic resources may be presented in the aquatic inventory section for this Subbasin (see Section 31). Refer to Appendix H for a more comprehensive list of the BPA and non-BPA funded projects conducted in this Subbasin and the entire IMP.

33.3.1 BPA Funded Projects

Project #1992-048-00 Colville Tribes Hellsgate Wildlife Mitigation
Project Description:
The focus of the Hellsgate Project is the protection, restoration, and enhancement of critical winter habitat for big game and shrub-steppe/sharp-tailed grouse habitat on lands purchased/managed for mitigation on the Colville Indian Reservation. At present, the Hellsgate Project protects and manages 25,501 acres for the biological requirements of

wildlife (CCT 2004). Currently there are 12 management units that make up the Hellsgate Project, most are located on or near the Columbia River (Lake Rufus Woods and Lake Roosevelt) and surrounded by Tribal land. These management units contain a wide diversity of vegetative types and habitats for a variety of wildlife.

Associated Monitoring:
- Monitor T&E species and habitats of concern.
- Conduct HEP to evaluate habitats and collect HU data for mitigation accounting.
- Conduct annual Neo-tropical birds surveys for species diversity using project lands.
- Conduct population and trend data to monitor habitat use and seasonal distribution.
- Coordinate with other agencies and Tribes on Columbia River mitigation issues and methodologies.

Accomplishments:
- Acquired 23,000 acres of habitat for mitigation.
- Protected 11,000 Habitat Units on acquired lands.
- Installed fencing on several units.
- Conducted noxious weed control on acquired lands.

Notes:
No enhancements to project lands to offset hydropower losses have taken place. Some small-scale enhancements have been conducted using USDA funds to plant native vegetation on selected sites.

Project # 21034 Colville Tribes Habitat Restoration and Adaptive Management of Columbian Sharp-tailed Grouse on the Intermountain Province

Project Description:
Develop and implement an adaptive management plan that will include restoration of native plant communities on lands within the IMP to support viable meta-populations of Columbia sharp-tailed grouse.

Associated Monitoring:
Monitor sharp-tailed grouse and their habitats using scientific principals and techniques to ensure that project objectives are being met and to provide a basis for use of adaptive management when appropriate. To evaluate species and habitat responses to management activities for the benefit of sharp-tailed grouse and other wildlife using similar habitats. Develop a Habitat Suitability Index for our area and create a sharp-tailed grouse management plan for the Colville Reservation.

Accomplishments:
- Literature review of all information concerning sharp-tailed grouse on the IMP.
- Conducted grouse surveys on known and historic leks.
- Surveyed for new leks.
- Trapped and collected data on marked 48 birds fitted with radio collars.
- Followed and mapped habitats used by marked grouse throughout the year.

- Conducted genetic variance tests on trapped birds.
- Determined sharp-tailed grouse seasonal ranges and associated GIS maps.
- Formed and coordinated with a regional grouse team for support and input.
- Reported progress through quarterly reports and unpublished papers.
- Conducted a public outreach program to inform individuals of status and future of sharp-tailed grouse on the Colville Indian Reservation and the IMP.

Notes:
This is currently the last year of funding for the sharp-tailed grouse project. The regional grouse team agrees that this is an extremely important project that addresses concerns of various agencies throughout the region dealing with a State Threatened and Endangered species. It is the recommendation of the regional grouse team that future funding for this project be a priority within the IMP and that the work continue to conserve and protect this species and associated habitats.

Project # 199106200 Spokane Tribe Wildlife Mitigation: Blue Creek Winter Range
Project Description:
Protect wildlife habitat as partial mitigation for the Grand Coulee Dam construction and inundation wildlife loss assessment through fee title and tribal allotment title acquisition on or adjacent to the Spokane Indian Reservation. The project was initially started as acquiring land within the Blue Creek Winter Range area, but has come to include all wildlife mitigation land acquisitions. The current priority areas include McCoy Lake Watershed, Wellpinit Mt., and the Peaks (shrub-steppe/steppe habitat). The Spokane Tribes wildlife projects can be acquired in both the Spokane and Upper Columbia subbasins.

Accomplishments:
- Between 1996 and 1999, the Spokane Tribe acquired 1,863 acres of wildlife lands of which 200 acres are located within the Upper Columbia Subbasin.
- The project was approved for a total of $4.5 million in acquisitions for FY02-03, but no projects were funded due to the BPA financial crisis
- To date in FY04, the Tribe has acquired 1,151 additional acres of mitigation lands in the Spokane Subbasin, but near the border of the Upper Columbia.

Project #199800300 Spokane Tribe Wildlife Mitigation Operation and Maintenance
Operate and Maintain wildlife lands that have been acquired through Project # 199106200. Management activities include fencing, noxious weed control, road maintenance, site clean-up and etc.. The habitat enhancement activities that are occurring on these lands are being conducted with tribal funds. During the 2000 Rolling Review Process the project included the Sharp-tailed Grouse Re-introduction Feasibility Study that has been delayed due to the BPA financial crisis, but should be completed in 2004.
Associated Monitoring:
- Conduct initial HEP analysis on projects within 1 year of acquisition and then every 5 years there after.
- Habitat Monitoring includes tree and shrub survival surveys, native grass/forb restoration establishment surveys and photo point monitoring.

- Wildlife Population Monitoring includes Ruffed Grouse Drum Counts, Bird Point Counts, Small Mammal Trapping, Big Game Counts, Bald Eagle Surveys, and Incidental Wildlife Observations.

Accomplishments:

- Since 2001, over 16,000 riparian trees and shrubs have been planted within the McCoy Lake Watershed (non-BPA funding)
- McCoy Creek Stream Channel Restoration: 1000' of the stream channel was constructed to near original characteristics. Riparian tree and shrub planting will be conduct on the site in 2005 (non-BPA funding).
- Conversion of over 60 acres of old agricultural land to native grass.

33.3.2 Non-BPA Funded Projects

Fischer Riparian Improvement

Project Description:

Fence riparian area; plant hardwoods to help hold water and improve wildlife-habitat. The project is sponsored by the FCD. This project ended in 2002.

Associated Monitoring:

Regular inspection by landowner; annual inspection by FCD staff.

Accomplishments:

Excluded cattle from riparian area, improved water retention, fish and wildlife-habitat. This project was designed to target several water quality issues, such as sediment loading, dissolved oxygen, fecal coliform.

Strandberg Stock Water Project

Project Description:

Through cost-share assistance, helped a landowner install non-freeze water troughs to keep cattle away from stream and improve range utilization. This project was also used to help educate other landowners to implement similar projects, through the same grant, other programs, and help them find incentives without government cost-share programs. This project ended in 2002.

Associated Monitoring:

Regular monitoring by FCD staff.

Accomplishments:

Enabled landowner to fence stock away from flowing stream; lowered fecal coliform levels. Other landowners worked on similar projects without cost-share assistance, and along with the educational component of a WDOE, Centennial Clean Water Funding we have been able to create a watershed management team and educate a considerable number of landowners and interested public.

Water and Soil Protection Project (WASP)

Project Description:

The intent of WASP was to partner with landowners and other natural resource agencies to conduct a cost-share program, offer technical assistance, and provide public information and educational outreach programs for water quality improvement and protection. Eligible activities included streambank stabilization, riparian vegetation restoration, spraying of noxious weeds, riparian fencing, hard crossings, off stream watering improvements and erosion control BMPs. Also provided was free engineering to landowners and agencies through a separate engineering grant for implementation projects. The project was funded by the Washington State Conservation Commission and ended in 2002.

Associated Monitoring:

Continued Monitoring by FCD Staff.

Accomplishments:

Technical assistance including permit processing, on-the-ground site surveying, and engineering design development with NRCS and the N.E. Area District Engineers were facilitated by FCD. Numerous other landowners were offered technical assistance to help them address water quality problems on their lands.

On-the-ground accomplishments for these projects resulted in several hundred feet of streambank stabilization through engineered designs and bioengineering projects. Many acres of erosion control and habitat development came from planting grass mixture, shrubs, and trees. Additional acres of steep slopes of noxious weed (knapweed) [received chemical treatments] to prevent further erosion and aid in the re-establishment of beneficial plants. These activities were conducted on the San Poil Watershed (WRIA 52) and Kettle River Watershed (WRIA 60).

WASP has had a very positive impact on the Ferry County landscape and has enabled FCD to educate and assist local families to improve water quality functions and values. Each engineered and bioengineering design, as well as other water and landscape BMPs that are implemented, provide a testing ground for the District upon which to refine BMP designs and applications.

Water and Soil Protection Project II (WASP II)

Project Description:

The intent of WASP II (continuing the concepts from WASP) was to partner with landowners and other natural resource agencies to conduct a cost-share program, offer technical assistance, and provide public information and educational outreach programs for water quality improvement and protection. Eligible activities included streambank stabilization, riparian vegetation restoration, spraying of noxious weeds, riparian fencing, hard crossings, off stream watering improvements and erosion control BMPs. Also provided was free engineering to landowners and agencies through a separate engineering grant for implementation projects. The project was funded by the Washington State Conservation Committee and ended in 2002.

Associated Monitoring:
Continued Monitoring by FCD Staff.

Accomplishments:
Technical assistance including permit processing, on-the-ground site surveying, and engineering design development with NRCS and the N.E. Area District Engineers were facilitated by FCD. Numerous other landowners were offered technical assistance to help them address water quality problems on their lands.

On-the-ground accomplishments for these projects resulted in several hundred feet of streambank stabilization through engineered designs and bioengineering projects. Many acres of erosion control and habitat development came from planting grass mixture, shrubs, and trees. Additional acres of steep slopes of noxious weed (knapweed) [received chemical treatments] to prevent further erosion and aid in the re-establishment of beneficial plants. These activities were conducted on the San Poil Watershed (WRIA 52) and Kettle River Watershed (WRIA 60).

WASP II has had a very positive impact to the Ferry County landscape and has enabled FCD to educate and assist local families to improve water quality functions and values. Each engineered and bioengineering design, as well as other water and landscape BMPs that are implemented, provide a testing ground for the District upon which to refine BMP designs and applications.

Water and Soil Protection Project III (WASP III)
Project Description:
The intent of WASP III (continuing the concepts from WASP II) was to partner with landowners and other natural resource agencies to conduct a cost-share program, offer technical assistance, and provide a public information and educational outreach programs for water quality improvement and protection. Eligible activities included streambank stabilization, riparian vegetation restoration, spraying of noxious weeds, riparian fencing, hard crossings, off stream watering improvements and erosion control BMPs. Also provided was free engineering to landowners and agencies through a separate engineering grant for implementation projects. The project is funded by the Washington State Conservation Committee, and is scheduled to end at the end of 2003.

Associated Monitoring:
Continued Monitoring by FCD Staff.

Accomplishments:
Technical assistance including permit processing, on-the-ground site surveying, and engineering design development with NRCS and the N.E. Area District Engineers were facilitated by FCD. Numerous other landowners were offered technical assistance to help them address water quality problems on their lands.

On-the-ground accomplishments for these projects resulted in several hundred feet of streambank stabilization through engineered designs and bioengineering projects. Many acres of erosion control and habitat development came from planting grass mixture,

shrubs, and trees. Additional acres of steep slopes of noxious weed (knapweed) [received chemical treatments] to prevent further erosion and aid in the re-establishment of beneficial plants. These activities were conducted on the San Poil Watershed (WRIA 52) and Kettle River Watershed (WRIA 60).

WASP III has had a very positive impact to the Ferry County landscape and has enabled FCD to educate and assist local families to improve water quality functions and values. Each engineered and bioengineering design, as well as other water and landscape BMPs that are implemented, provide a testing ground for the District upon which to refine BMP designs and applications.

Riparian Demonstration and Education Project (RDEP)

Project Description:

The RDEP implemented riparian protection, enhancement, and restoration for water quality benefits throughout FCD in WRIA 52, 58, and 60. This project met the challenge of protection and restoration of riparian areas adjacent streams and lakes in such a manner that maintains water quality integrity while improving, protecting, or enhancing fish and wildlife-habitat. The implementation projects in this program are available for use in individual, group, associations, and schools for education efforts into the future. Many varieties of BMPs have been implemented and landowners can view the different strategies used to create the various types of environmental protection and enhancement that were utilized. This project is funded by the WDOE and sponsored by the FCD. The project is scheduled to end in 2003.

Associated Monitoring:

FCD Staff continue the monitoring efforts for this project.

Accomplishments:

Developed a Riparian Education and Demonstration Program to include implementation of projects on the FCD property, and a native plant nursery for use in this and future implantation projects. Conducted a partnering restoration effort with several individual landowners, agencies, the Colville Confederated Tribes, and School Districts (as far as Seattle). Implemented an extensive public education and information program. Perform a comprehensive monitoring program.

FCD Native Plant Nursery

Project Description:

Establish a Native Plant Nursery to provide plants for revegetation and restoration projects throughout the Conservation District, and the greater area, as available. The project is ongoing and sponsored by the FCD.

Associated Monitoring:

Constant monitoring of plant health and growth. Annual assessment of overall progress.

Accomplishments:

Have established and propagated locally unique varieties of seven different native

hardwood species and three different softwoods.

Sherman Creek Implementation Project

Project Description:

Planted native hardwood and softwood species along the banks of Sherman Creek. This project ended in 2001 and was sponsored by FCD.

Associated Monitoring:

Regular monitoring by FCD staff and USFS personnel.

Accomplishments:

Reestablished riparian buffers to provide shade, fish and wildlife-habitat.

Sherman Creek Wildlife Area

Project Description:

The Sherman Creek Wildlife Area is owned and managed by WDFW. The 8,782 acre wildlife area is managed primarily for deer winter range. Additional management activities provide habitat protection and improvement for non-game birds, waterfowl, and upland birds. Wildlife management programs traditionally focus on habitat manipulation including farming, shrub plantings, timber sales, forage enhancement seedlings, and weed control. Farming has occurred on up to 200 acres, with 100 acres of irrigated farming.

Associated Monitoring:

Breeding Bird point count and area search surveys are conducted annually. The area is also included in general Game Management Unit mule deer and white-tailed deer composition counts. Planted crops or shrubs are monitored and evaluated on a regular basis. Weed control is regulated by Ferry County and monitored regularly by WDFW.

Accomplishments:

Approximatley 1,785 acres of deer and other wildlife habitat has been enhance through timber management. Noxious weed control has been aggressive and implemented annually for at least the last decade. There is not a sufficient O&M budget to facilitate a full time manager so that is the primary limitation to further accomplishments or monitoring.

Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP) and Wildlife-habitat Incentives Program (WHIP)

Project Description:

These programs help eligible participants implement structural and management practices to address soil, water and related natural resources concerns on their lands. These programs encourage landowners to convert environmentally sensitive acreage to vegetative cover, such as native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. These projects are funded by the USDA and are continuing.

Associated Monitoring:
The implementation projects are periodically inspected to insure the effectiveness of the new conservation practices.

Accomplishments:
CRP, EQIP, and WHIP aid in reducing soil erosion and sedimentation in streams and lakes, improving water quality, establishing wildlife-habitat, and enhancing forest and wetland resources.

Road Surface Treatment
Project Description:
The Lincoln County Public Works has used a magnesium chloride dust suppressant and road base stabilizer in Lincoln County. The dust guards attract moisture and are used for dust and erosion control. This project is funded through a Lincoln County tax assessment and is ongoing.

Associated Monitoring:
None.

Accomplishments:
Applying dust control treatments will help maintain natural surfaces. In addition, it will help prevent wind blown dust and eroded soils from entering any water system.

33.4 Strategies Currently Being Implemented Through Existing Projects

33.4.1 Limiting Factors and Strategies

Refer to Figure 31.1 of the Aquatic Inventory section for a graph displaying the percent of all fish and wildlife mitigation projects in the Subbasin that respond to specific limiting factors. Wildlife mitigation projects in the Subbasin respond primarily to the limiting factors of habitat quantity and quality; in addition, the sharp-tailed grouse, mule deer, and cougar DNA projects addressed lack of information on the species.

Figure 31.2 of the Aquatic Inventory section shows the types of management strategies used in the fish and wildlife mitigation projects in the Subbasin. Wildlife mitigation projects in the Subbasin have used primarily the habitat acquisition and habitat improvement/restoration strategies. Other strategies include watershed planning/recovery planning, RM&E, and education.

33.4.2 Gaps Between Actions Taken and Actions Needed

The primary terrestrial resources mitigation need in the subbasin, with respect to the FCRPS, is completion of the construction loss mitigation for the Grand Coulee Project. The construction loss assessment was completed in 1986 (Creveling and Renfrow 1986). Currently, the mitigation for the construction wildlife losses in terms of Habitat Units (HUs) is about 51 percent complete (refer to Section 24). Acquisition of HUs for the Washington State threatened sage grouse has been completed; future enhancement and

monitoring funding will be necessary to improve and maintain habitat values. Acquisition of HUs for the Washington State threatened sharp-tailed grouse is approximately 52 percent complete. Populations of this species are considered at very high risk in the state and continued action to enhance habitats and populations in the province is needed.

Additional funding for habitat acquisitions, enhancement and/or restoration measures, and maintenance funding will be necessary to meet the existing construction loss mitigation obligation.

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SECTION 34 – Table of Contents

34 Upper Columbia Management Plan

The Upper Columbia Subbasin Management Plan was developed by the Upper Columbia Subbasin Work Team. Detailed information describing the membership and formation of the Subbasin Work Teams and the process used to develop and adopt the management plan can be found in Section 1.2. In general, the components of the management plan, including the subbasin vision, guiding principles, and prioritized biological objectives and strategies were developed in a series of six meetings between June 2003 and March 2004.

The Oversight Committee (OC), Technical Coordination Group, and the Upper Columbia Subbasin Work Team worked collaboratively to establish technically sound objectives and strategies that respond to the limiting factors identified in the subbasin assessment. The management plan was developed in several iterations between the OC and Subbasin Work Teams and the Technical Coordination Group.

Biological objectives were developed using a tiered approach. The Council developed the Columbia River Basin biological goals based on the scientific principles identified in the 2000 Fish and Wildlife Plan. The OC established the province level objectives under the Columbia River Basin level goals by responding to recommendations from the GEI Team, the Technical Coordination Group, and the Subbasin Work Teams. The Subbasin Work Teams developed the subbasin level biological objectives and strategies under the Province objectives, with assistance from the Technical Coordination Group and the GEI Team.

34.1 Summary of Upper Columbia Assessment and Limiting Factors

The vision and biological objectives of the management plan reflect what is learned in the assessment and inventory work. In the Upper Columbia Subbasin, the aquatic and terrestrial assessments and inventories are described in detail in sections 30 to 33 of this document. A brief overview of the key limiting factors that are addressed in this management plan is included below.

34.1.1 Upper Columbia Aquatic Assessment and Limiting Factors

Focal species selected in the Upper Columbia Subbasin include white sturgeon, redband/rainbow trout, kokanee salmon, Chinook, Pacific lamprey, and burbot. In addition, the subbasin plan recognizes westslope cutthroat trout as an important native species that still occur in limited geographic areas. Both Chinook and Pacific lamprey were completely lost from the Subbasin when Grand Coulee Dam was constructed without fish passage. White sturgeon are still present in small numbers, but are no longer able to exist in an anadromous life history form. Burbot are a native species, but little is known about their current status. Redband/rainbow and kokanee are native species that are important for recreational and subsistence fisheries.

Overall, the most important limiting factors for fisheries in the Upper Columbia Subbasin resulted from the construction of Grand Coulee Dam and the subsequent loss of

anadromous fishes and the conversion of rivers into reservoirs. The loss of the anadromous life history in the blocked area had a wide range of impacts on the fish, wildlife, and people of the area. These impacts are described in more detail in sections 2.2 and 1.4.1, but include loss of aquatic productivity, loss of fishing opportunity, increased fishing and hunting pressure on other species, and increased stocking of nonnative species. These limiting factors are addressed in the Upper Columbia Subbasin Management Plan through objectives 2A4, 1A5, 2C1, 2D1, and 1A3.

We used QHA modeling to help us assess the limiting factors in the rivers and streams of the Subbasin. The most significant stream habitat limiting factors for the salmonid focal species are listed in Tables 34.1-1, 34.1-2, 34.1-3. In parentheses is the number of reaches or watersheds within the Upper Columbia Subbasin where that particular habitat attribute is the worst habitat-related limiting factor. The numbers in the Objective column correspond to the subbasin objectives that were developed in this management plan to address this limiting factor. Aquatic objectives for the Upper Columbia Subbasin are described in more detail in section 34.3.

Table 34.1-1. Stream habitat conditions that currently most deviate from the reference for adfluvial rainbow trout, Upper Columbia Subbasin. The number in parenthesis is the number of reaches or watersheds within the Upper Columbia Subbasin where that particular habitat attribute is the worst habitat-related limiting factor. The numbers in the Objective column correspond to the subbasin objective that was developed to address this limiting factor in section 34.3.

Adfluvial Rainbow	
Habitat Condition	**Objective**
Habitat Diversity (13)	1B2, 1A2, 1B7, 1A3
Obstructions (8)	1B2, 1B1
Fine Sediment (5)	1B2, 1B5, 1B4
Riparian Condition (2)	1B2, 1B6, 1A2
Channel Stability (1)	1B2, 1A2, 1B7
Low Flow (1)	1B2, 1B8
High Temperatures (5)	1B2, 1B3
Oxygen (2)	1B2, 1A4, 1A1
Low Temperature (1)	1B2
Pollutants (1)	1B2, 1B4

Table 34.1-2. Stream habitat conditions that currently most deviate from the reference for resident rainbow trout, Upper Columbia Subbasin. The number in parenthesis is the number of reaches or watersheds within the Upper Columbia Subbasin where that particular habitat attribute is the worst habitat-related limiting factor. The numbers in the Objective column correspond to the subbasin objective that was developed to address this limiting factor in section 34.3.

Resident Redband/Rainbow	
Habitat Condition	**Objective**
Habitat Diversity (32)	1B2, 1A2, 1B7, 1A3
Riparian Condition (22)	1B2, 1B6, 1A2
Obstructions (21)	1B2, 1B1

Resident Redband/Rainbow	
Habitat Condition	**Objective**
Channel Stability (8)	1B2, 1A2, 1B7
Fine Sediment (8)	1B2, 1B5, 1B4
Low Flow (7)	1B2, 1B8

Table 34.1-3. Stream habitat conditions that currently most deviate from the reference for kokanee, Upper Columbia Subbasin. The number in parenthesis is the number of reaches or watersheds within the Upper Columbia Subbasin where that particular habitat attribute is the worst habitat-related limiting factor. The numbers in the Objective column correspond to the subbasin objective that was developed to address this limiting factor in section 34.3.

Kokanee	
Habitat Condition	**Objective**
Oxygen (13)	1B2, 1A4, 1A1
Obstructions (5)	1B2, 1B1
Fine Sediment (1)	1B2, 1B5, 1B4
Pollutants (1)	1B2, 1B4
High and Low Flows (1)	1B2, 1B8

Within the Upper Columbia Subbasin habitat diversity was most often the habitat variable that deviated the greatest from the reference condition for both adfluvial and resident redband/rainbow trout streams. Obstructions were also rated as a significant limiting factor for all the salmonid focal species. For kokanee streams, low oxygen was the most common limiting habitat variable.

Other limiting factors have negatively affected native fish populations within the Upper Columbia Subbasin. Large mainstem fish barriers, changes in timing, quality, and quantity of river flows, increased slack water habitat due to the impoundment of the mainstem Columbia River, and nonnative species introductions have all influenced the fish assemblage of the Upper Columbia Subbasin. Management plan objectives designed to address the impacts of Grand Coulee Dam on the Upper Columbia Subbasin include 1A1, 2D1, 1A2, 1A3, 1A4, and 1B4. Management plan objectives designed to address nonnative fish issues include 2A1, 1A5, 2C1.

34.1.2 Upper Columbia Terrestrial Assessment and Limiting Factors

Wildlife in the Upper Columbia Subbasin are limited by habitat quantity and quality. Construction of the Grand Coulee Project affected over 56,000 acres of lands, the majority of which were located in the Upper Columbia Subbasin. In addition, the project had a number of secondary effects to terrestrial resources, including accelerated rates of industrial, agricultural, and residential development leading to loss of habitat; increased hunting pressure on wildlife; and loss of salmonid nutrients to the ecosystem.

Factors that currently limit terrestrial resources in the Subbasin are dominated by loss of habitat and modification of habitat quality as a result of human land uses. Development, including urban, suburban, and agricultural land uses, has converted a total of 12 percent

of native habitats to other cover types. Road densities are high throughout most of the Subbasin and few large tracts of protected lands are present.

Management plan objectives that address the losses from the construction of and inundation from Grand Coulee Dam are Objective 1A and associated sub-objectives. Management plan objectives that address the operational impacts to terrestrial species and habitats are Objective 1B and associated sub-objectives. Objectives 2A and 2B address secondary impacts of the hydropower system and other subbasin effects to terrestrial resources.

34.2 Subbasin Vision

The vision for the Upper Columbia Subbasin is:

> *We envision the Upper Columbia Subbasin being comprised of and supporting viable, diverse fish and wildlife populations, and their habitats that contribute to the social, cultural, and economic wellbeing of the Pacific Northwest.*

In addition to the vision, the Upper Columbia Subbasin Work Team members drafted the following guiding principles:

1. Subbasin planning must be consistent with the Northwest Power Act, Northwest Power and Conservation Council's Fish and Wildlife Program and technical guidance for subbasin planning, while complimenting existing plans, policies, and planning efforts.
2. To the extent possible, acknowledge, consider, and incorporate trans-boundary issues and information.
3. Human interests can be balanced with fish and wildlife needs.
4. All people are stewards for future generations.
5. Fish and wildlife species and habitat should be managed in perpetuity based on best available scientific, ecological, and biological principles, not political agendas (for example, use adaptive management).
6. Subbasin plans will address fish and wildlife use for cultural and subsistence purposes.
7. Public involvement and education is essential for successful plan development and implementation.

34.3 Aquatic Objectives and Strategies

The subbasin objectives and strategies are prioritized. Strategies are listed in priority order. The ranking of the objectives are given in parenthesis after the objective. Objectives and strategies also included in the research, monitoring, and evaluation plan are marked with an asterisk.

Columbia River Basin Level Category 1: Mitigate for resident fish losses.

Columbia River Basin Level Goal 1A:
Complete assessments of resident fish losses throughout the Columbia River Basin resulting from the federal and federally-licensed hydrosystem, expressed in terms of the various critical population characteristics of key resident fish species.

Province Level Objective 1A:
Fully mitigate fish losses related to construction and operation of federally licensed and federally operated hydropower projects.

Subbasin Objective 1A1*: Continue to evaluate hydropower impacts to native and focal species. Implement strategies to reduce impacts. (Priority 7)

Strategy a*: Develop and implement plans to reduce hydropower impacts to native and focal species.

Strategy b: Continue to evaluate plans to reduce hydropower impacts to native and focal species.

Strategy c*: Monitor entrainment.

Strategy d: Reduce entrainment at Grand Coulee Dam where desirable.

Subbasin Objective 1A2: Expand stable littoral zones along Lake Roosevelt by 10 percent of lake surface area (at elevation 1,290 ft). (Priority 13)

Strategy a: Use vegetation enhancements, annual seeding and water retention in backwater areas to increase near-shore fish production, increase shoreline stability, and reduce erosion.

Strategy b: Increase water retention time in reservoirs to increase zooplankton production and reduce entrainment of juveniles.

Strategy c: Develop technical and policy working groups that meet regularly to identify problems and implement solutions.

Strategy d: Modify dam operation.

Subbasin Objective 1A3: Assess and implement a nutrient enrichment program for Lake Roosevelt and tributaries. (Priority 14)

Strategy a: Assess feasibility and potential effectiveness of nutrient enrichment in Lake Roosevelt and tributaries.

Strategy b: Use vegetation enhancements, annual seeding and water retention in backwater areas to increase near-shore fish production, increase shoreline stability, and reduce erosion.

Strategy c: Return nutrients lost through the extirpation of salmon stocks consistent with prudent disease and fish health practices and applicable water quality standards.

Strategy d: Increase water retention time in reservoirs to increase zooplankton production and reduce entrainment of juveniles.

Strategy e: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Subbasin Objective 1A4: Attain total dissolved gases (TDG) below 110 percent saturation for the mainstem Columbia River. (Priority 16)

Strategy a: Participate in technical and policy working groups (for example, TDG and TMDL groups) to develop changes in hydrosystem operations and/or physical attributes of dams to reduce TDG.

Subbasin Objective 1A5: Restore resident fish **s**pecies (subspecies, stocks and populations) using artificial production. (Priority 4)

Strategy a: Maintain and improve existing artificial production programs/net pen operations.

Strategy b: Use locally adapted native redband rainbow trout stock, where biologically prudent, to supplement natural populations and for harvest applications where emigration can occur.

Strategy c: Develop artificial production capacity for kokanee salmon that utilizes locally adapted stocks.

Strategy d: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Columbia River Basin Level Goal 1B:
Maintain and restore healthy ecosystems and watersheds, which preserve functional links among ecosystem elements to ensure the continued persistence, health and diversity of all species including game fish species, non-game fish species, and other organisms. Protect and expand habitat and ecosystem functions as the means to significantly increase the abundance, productivity, and life history diversity of resident fish at least to the extent that they have been affected by the development and operation of the federal and federally-licensed hydrosystem.

Province Level Objective 1B:
Protect and restore in-stream and riparian habitat to maintain functional ecosystems

for resident fish, including addressing the chemical, biological, and physical factors influencing aquatic productivity.

Subbasin Objective 1B1: Restore connectivity of salmonid habitat as appropriate by 2015. (Priority 10)

Strategy a: Develop and utilize consistent barrier criteria and inventory methodology to be used province-wide by agencies/managers.

Strategy b: Inventory and prioritize all fish passage barriers by 2006.

Strategy c: Remove artificial migration barriers as to allow fish passage where prudent to increase habitat quantity for migratory fish species.

Strategy d*: Develop minimum in-stream flow recommendations for fish bearing streams that meet the biological requirements of salmonid fishes, including focal species.

Strategy e: Develop technical and policy working groups (for example, Lake Roosevelt Fisheries Evaluation Program) that meet regularly to identify problems and implement solutions.

Subbasin Objective 1B2: Begin implementation of habitat strategies for addressing identified limiting factors for all focal species and native fishes by 2005. (Priority 1)

Strategy a: Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species.

Strategy b: Utilize or create, where needed, incentive program for private landowners to implement strategies to achieve this objective.

Strategy c: Minimize negative impacts (competition, predation, introgression) to native species from nonnative species and stocks.

Strategy d: Use appropriate methodologies to remove nuisance species.

Strategy e: Limit livestock in riparian areas and replant native riparian plants where needed.

Strategy f: Remove artificial migration barriers to allow fish passage where prudent to increase habitat quantity for migratory fish species.

Strategy g: Decommission roads wherever possible and develop road abandonment plans for federal, state, and Tribal lands to reduce road densities and meet appropriate water quality standards.

Strategy h: Use vegetation enhancements, annual seeding and water retention in backwater areas to increase near-shore fish production, increase shoreline stability, and reduce erosion.

Strategy i: Increase water retention time in reservoirs to increase zooplankton production.

Strategy j: Develop minimum in-stream flow recommendations for fish-bearing streams that meet the biological requirements of salmonid fishes, including subbasin identified focal species.

Strategy k: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Subbasin Objective 1B3: Maintain and/or achieve stream temperatures below 18^{o}C for all streams that support salmonid populations. (Priority 12)

Strategy a: Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species.

Strategy b: Develop or utilize programs that put water into streams (placing water rights into trust).

Strategy c: Limit livestock in riparian areas and replant native riparian plants where needed.

Strategy d: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Strategy e: Restore sinuosity to channelized streams.

Strategy f: Remove small dams as appropriate.

Strategy g: Develop minimum in-stream flow recommendations for fish-bearing streams that meet the biological requirements of salmonid fishes, including subbasin identified focal species.

Subbasin Objective 1B4*: Evaluate heavy metal/organic/inorganic contamination as a limiting factor on native, culturally, and economically important species. (Priority 17)

Strategy a*: Conduct the evaluation.

Strategy b: Implement the assessment recommendations.

Subbasin Objective 1B5: Improve or maintain streambed embeddedness between 20 percent and 30 percent in all streams with known salmonid populations. (Priority 11)

Strategy a: Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species.

Strategy b: Limit livestock in riparian areas and replant native riparian plants where needed.

Strategy c: Decommission roads wherever possible and develop road abandonment plans for federal, state and Tribal lands to reduce road densities and meet appropriate water quality standards.

Strategy d: Develop technical and policy working groups that meet regularly to identify problems and implement solutions.

Subbasin Objective 1B6: Enhance, conserve, and protect riparian habitats to the extent that 80 percent of each stream's riparian areas remain intact and functional. (Priority 9)

Strategy a: Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species.

Strategy b: Limit livestock in riparian areas and replant native riparian plants where needed.

Strategy c: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Strategy d*: Develop criteria for prioritizing streams and/or stream reaches within the Subbasin for habitat improvements, including prioritization of work with identified native red-band rainbow trout habitat, and/or other focal species strongholds.

Strategy e: Decommission roads wherever possible and develop road abandonment plans for federal, state and Tribal lands to reduce road densities and meet appropriate water quality standards.

Subbasin Objective 1B7: Reduce width to depth ratios to < 10 for all streams within the Subbasin, as appropriate. (Priority 18)

Strategy a: Reduce stream bank disturbances from agriculture and recreational practices.

Strategy b: Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species.

Strategy c: Limit livestock from riparian areas and replant native riparian plants where needed.

Strategy d: Utilize or create, where needed, incentive programs for private landowners to implement strategies to achieve this objective.

Strategy e*: Develop criteria for prioritizing streams and/or stream reaches within the Subbasin for habitat improvements, including prioritization of work with identified native red-band rainbow trout habitat, and/or other focal species strongholds.

Strategy f: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Strategy g: Decommission roads wherever possible and develop road abandonment plans for federal, state and Tribal lands to reduce road densities and meet appropriate water quality standards.

Subbasin Objective 1B8: Protect, maintain, and enhance flows appropriate for all life stages of focal and native fish species in all intermittent, ephemeral, and perennial streams. (Priority 15)

Strategy a: Implement reclamation, reuse, conservation, storage, and ground and surface water recharge.

Strategy b: Ensure all water rights are defined and enforced.

Strategy c*: Develop minimum in-stream flow and target flow recommendations for fish bearing streams, that meet the biological requirements of salmonid fishes, including subbasin identified focal species

Strategy d: Improve enforcement of environmental regulations.

Columbia River Basin Level Goal 1C:
Restore resident fish species (subspecies, stocks and populations) to near historic abundance throughout their historic ranges where suitable habitat conditions exist and/or where habitats can be restored

Province Level Objective 1C1:
Protect, enhance, restore, and increase distribution of native resident fish populations and their habitats in the IMP with primary emphasis on sensitive, native salmonid stocks.

Province Level Objective 1C2:
Maintain and enhance self-sustaining, wild populations of native game fish, and subsistence species, to provide for harvestable surplus.

Province Level Objective 1C3:
Minimize negative impacts (competition, predation, introgression) to native species from nonnative species and stocks.

Province Level Objective 1C4:
Increase cooperation and coordination among stakeholders throughout the province.

In the Upper Columbia Subbasin, objectives that address the topics listed in Province level objectives 1C1 – 1C4 are covered in Category 2, below.

Province Level Objective 1C5:
Meet and exceed the recovery plan goals for federally-listed threatened and endangered fish species.

Subbasin Objective 1C1: The Upper Columbia Subbasin is within the Northeast Washington Bull Trout Recovery Unit, and is identified as a "research needs area" (USFWS 2002). Surveys are needed to determine how or if the Subbasin can contribute to recovery. (Priority 5)
(Refer to http://pacific.fws.gov/bulltrout/recovery.htm)

Strategy a*: Conduct bull trout distribution and habitat suitability surveys.

Province Level Objective 1C6:
Restore resident fish **s**pecies (subspecies, stocks and populations) to near historic abundance throughout their historic ranges where suitable habitat conditions exist and/or where habitats can be restored.

In the Upper Columbia Subbasin, objectives that address the topics listed in Province level Objective 1C6 are covered in Category 2, below.

Columbia River Basin Level Category 2: Substitute for anadromous fish losses.

Columbia River Basin Level Goal 2A:
Restore **resident fish** species (subspecies, stocks and populations) to near historic abundance throughout their historic ranges where suitable habitat conditions exist and/or where habitats can be feasibly restored.

Province Level Objective 2A1:
Protect, enhance, restore, and increase distribution of native resident fish populations and their habitats in the IMP with primary emphasis on sensitive, native salmonid stocks.

Province Level Objective 2A2:
Maintain and enhance self-sustaining, wild populations of native game fish, and subsistence species, to provide for harvestable surplus.

Province Level Objective 2A3:
Minimize negative impacts (competition, predation, introgression) to native species from nonnative species and stocks.

Province Level Objective 2A4:
Increase cooperation and coordination among stakeholders throughout the province.

The following subbasin objectives address province objectives 2A1 – 2A4:

Subbasin Objective 2A1: Protect the genetic integrity of all focal and native fish species throughout the Subbasin. (Priority 2)

Strategy a*: Determine genetic distribution of native focal species (white sturgeon, rainbow/redband trout, Pacific lamprey, burbot, kokanee), identify limiting factors, and develop strategies for addressing limiting factors by 2006.

Strategy b: Use locally adapted, genetically appropriate native stocks, where biologically prudent, to supplement natural populations and for harvest applications where emigration can occur.

Strategy c: Prevent introgression between hatchery and wild stocks through development and implementation of hatchery genetic management plans.

Strategy d: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Subbasin Objective 2A2: Maintain, restore, and enhance wild populations of native fish, and subsistence species to provide for harvestable surplus. (Priority 3)

Strategy a: Enhance native and focal species populations through habitat improvements.

Strategy b: Prevent introgression between hatchery and wild stocks through development and implementation of hatchery genetic management plans and follow IHOT guidelines.

Strategy c: Implement marking program to identify hatchery-produced trout from wild fish and for potential selective harvest regulations.

Strategy d: Artificially produce sufficient genetically appropriate native and focal species to fulfill management and harvest needs.

Strategy e: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Strategy f: Expand Chinook salmon and steelhead range and habitat wherever possible. See footnote 2.

Columbia River Basin Level Goal 2B:
Provide sufficient populations of fish and wildlife for abundant opportunities for Tribal trust and treaty right harvest and for non-Tribal harvest.

Province Level Objective 2B
Focus restoration efforts on habitats and ecosystem conditions and functions that will allow for expanding and maintaining diversity within, and among, species in order to sustain a system of robust populations in the face of environmental variation.

Objectives and strategies for Province Level Objective 2B in the Upper Columbia Subbasin were not developed. Objectives related to habitats, and ecosystem conditions and functions are listed under Objective 1B.

Columbia River Basin Level Goal 2C:
Administer and increase opportunities for consumptive and non-consumptive resident fisheries for native, introduced, wild, and hatchery reared stocks that are compatible with the continued persistence of native resident fish species and their restoration to near historic abundance (includes intensive fisheries within closed or isolated systems).

Province Level Objective 2C1:
Artificially produce sufficient salmonids to supplement consistent harvest to meet management objectives.

Province Level Objective 2C2:
Provide both short- and long-term harvest opportunities that support both subsistence activities and sport-angler harvest.

The following subbasin objective addresses province objectives 2C1 – 2C2:

Subbasin Objective 2C1: Artificially produce enough fish to supplement consistent harvest to meet state and tribal management objectives. (Priority 6)

Strategy a: Artificially produce sufficient fish to fulfill management and harvest needs.

Strategy b: Preserve and enhance net pen operations.

Strategy c: Enhance white sturgeon populations through habitat improvements and artificial production, in concert with the Upper Columbia White Sturgeon Recovery Plan.

Strategy d: Use genetically appropriate native stocks when possible.

Strategy e: Minimize negative impacts to native species from nonnative species and stocks.

Strategy f: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Columbia River Basin Level Goal 2D:
Reintroduce anadromous fish into blocked areas where feasible[1].

Province Level Objective 2D1:
Develop an anadromous fish re-introduction feasibility analysis by 2006 for Chief Joseph and by 2015 for Grand Coulee[2].

Subbasin Objective 2D1*: Evaluate feasibility of anadromous fish re-introduction by 2015, and begin implementation. (Priority 8)

Strategy a*: Conduct the study.

Strategy b: Expand Chinook salmon and steelhead range and habitat wherever possible.

Province Level Objective 2D2:
Develop an implementation plan within five years of feasibility determination for each facility.

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[1] OC notes that "where feasible" is actual language from Council's Program.

[2] At this time the WDFW has no formal agency position, pro or con, on possible reintroduction and/or establishment of anadromous Chinook or steelhead above Grand Coulee Dam. Consideration for re-establishment of anadromous salmonid stocks above Grand Coulee Dam should be carefully evaluated in light of Upper Columbia Subbasin habitat conditions, and potential impacts upon existing resident fish substitution programs currently in place to partially mitigate for the loss of historic anadromous fish resources.

34.3.1 Prioritization of Aquatic Objectives

A detailed discussion of the methods used to prioritize the objectives and strategies is found in Section 1.2. In Upper Columbia Subbasin, the members of the Subbasin Work Team contributed to the development of ranking criteria which were based largely on the criteria in the Council's 2000 Fish and Wildlife Program. The ranking criteria were finalized by the IMP OC, but each Work Team was offered the option of adding additional Subbasin specific criteria to the ranking. They recommended that a new subbasin specific criteria be added for the terrestrial that would increase the priority of objectives that are mandated by the Northwest Power Act. Following discussion, the work team decided to add the following subbasin specific criteria:

- Terrestrial subbasin specific criteria – Is the objective/strategy mandated by the Northwest Power Act?

The Work Team rated the criteria for each objective from one to ten. An average ranking was calculated for each respondent for each objective, and then an overall Work Team average was calculated. Strategies were rated high, medium and low. These categories were converted to numeric values: 3, 2, and 1 respectively. The average ranking for each strategy was calculated for each respondent and for the Work Team as a whole.

The Work Team discussed the preliminary prioritization results for the objectives and strategies at the sixth Work Team meeting, and based on a consensus decision agreed to the final prioritization of the objectives and strategies.

The final prioritization of the aquatic objectives for the Upper Columbia Subbasin is displayed in Table 34.3-1.

Table 34.3-1. Ranking of objectives in the Upper Columbia Subbasin, with the limiting factor(s) that the objective was designed to address

Objectives in Priority Order	Strategies in Priority Order	Limiting Factor(s) Addressed
(1) Begin implementation of habitat strategies for addressing identified limiting factors for all focal species and native fishes by 2005. **Subbasin Objective 1B2**	**Strategy a:** Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species. **Strategy b:** Utilize or create, where needed, incentive program for private landowners to implement strategies to achieve this objective. **Strategy c:** Minimize negative impacts (e.g., competition, predation, introgression) to native species from nonnative species and stocks. **Strategy d:** Use appropriate methodologies to remove nuisance species. **Strategy e:** Limit livestock in riparian areas and replant native riparian plants where needed. **Strategy f:** Remove artificial migration barriers to allow fish passage where prudent to increase habitat quantity for migratory fish species. **Strategy g:** Decommission roads wherever possible and develop road abandonment plans for federal, state, and Tribal lands to reduce road densities and meet appropriate water quality standards. **Strategy h:** Use vegetation enhancements, annual seeding and water retention in backwater areas to increase near-shore fish production, increase shoreline stability, and reduce erosion. **Strategy i:** Increase water retention time in reservoirs to increase zooplankton production. **Strategy j:** Develop minimum in-stream flow recommendations for fish bearing streams, that meet the biological requirements of salmonid fishes, including subbasin identified focal species. **Strategy k:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.	Riparian habitat, water quality, nutrients, sediment
(2) Protect the genetic integrity of all focal and native fish species throughout the Subbasin. **Subbasin Objective 2A1**	**Strategy a*:** Determine genetic distribution of native focal species (white sturgeon,	Nonnative species, loss of anadromous life history

Objectives in Priority Order	Strategies in Priority Order	Limiting Factor(s) Addressed
	rainbow/redband trout, Pacific lamprey, burbot, kokanee), identify limiting factors, and develop strategies for addressing limiting factors by 2006. **Strategy b:** Use locally adapted, genetically appropriate native, stocks, where biologically prudent, to supplement natural populations and for harvest applications where emigration can occur. **Strategy c:** Prevent introgression between hatchery and wild stocks through development and implementation of hatchery genetic management plans. **Strategy d:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.	
(3) Maintain, restore, and enhance wild populations of native fish, and subsistence species, to provide for harvestable surplus. **Subbasin Objective 2A2**	**Strategy a:** Enhance native and focal species populations through habitat improvements. **Strategy b:** Prevent introgression between hatchery and wild stocks through development and implementation of hatchery genetic management plans and follow IHOT guidelines. **Strategy c:** Implement marking program to identify hatchery-produced trout from wild fish and for potential selective harvest regulations. **Strategy d:** Artificially produce sufficient genetically appropriate native and focal species to fulfill management and harvest needs. **Strategy e:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin. **Strategy f:** Expand Chinook salmon and steelhead range and habitat wherever possible.	Loss of anadromous life history, loss of lotic habitat, habitat degradation
(4) Restore **resident fish** species (subspecies, stocks and populations) using artificial production. **Subbasin Objective 1A5**	**Strategy a:** Maintain and improve existing artificial production programs/net pen operations. **Strategy b:** Use locally adapted native redband rainbow trout stock, where biologically prudent, to supplement natural populations and for harvest applications where emigration can occur. **Strategy c:** Develop artificial production capacity	Loss of anadromous life history, loss of lotic habitat, habitat degradation

Objectives in Priority Order	Strategies in Priority Order	Limiting Factor(s) Addressed
	for kokanee salmon that utilizes locally adapted stocks. **Strategy d:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin	
(5) The Upper Columbia Subbasin is within the Northeast Washington Bull Trout Recovery Unit, and is identified as a "research needs area" (USFWS 2002). Surveys are needed to determine how or if the Subbasin can contribute to recovery. **Subbasin Objective 1C1**	**Strategy a*:** Conduct bull trout distribution and habitat suitability surveys.	Lack of information
(6) Artificially produce enough fish to supplement consistent harvest to meet state and tribal management objectives. **Subbasin Objective 2C1**	**Strategy a:** Artificially produce sufficient fish to fulfill management and harvest needs. **Strategy b:** Preserve and enhance net pen operations. **Strategy c**: Enhance white sturgeon populations through habitat improvements and artificial production, in concert with the Upper Columbia White Sturgeon Recovery Plan. **Strategy d:** Use genetically appropriate native stocks when possible. **Strategy e**: Minimize negative impacts to native species from nonnative species and stocks **Strategy f:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.	Loss of anadromous life history, loss of lotic habitat, habitat degradation
(7) Continue to evaluate hydropower impacts to native and focal species. Implement strategies to reduce impacts. **Subbasin Objective 1A1***	**Strategy a*:** Develop and implement plans to reduce hydropower impacts to native and focal species. **Strategy b:** Continue to evaluate plans to reduce hydropower impacts to native and focal species. **Strategy c*:** Monitor entrainment. **Strategy d:** Reduce entrainment at Grand Coulee Dam where desirable.	Lack of information, loss of lotic habitat, water quality degradation
(8) Evaluate feasibility of anadromous fish re-introduction by 2015, and begin implementation. **Subbasin Objective 2D1***	**Strategy a*:** Conduct the study. **Strategy b:** Expand Chinook salmon and steelhead range and habitat wherever possible.	Loss of anadromous life history
(9) Enhance, conserve, and protect riparian habitats to the extent that 80	**Strategy a:** Conduct riparian habitat restoration,	Riparian habitat degradation

Objectives in Priority Order	Strategies in Priority Order	Limiting Factor(s) Addressed
percent of each stream's riparian areas remain intact and functional. **Subbasin Objective 1B6**	reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species. **Strategy b:** Limit livestock in riparian areas and replant native riparian plants where needed. **Strategy c:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin. **Strategy d*:** Develop criteria for prioritizing streams and/or stream reaches within the Subbasin for habitat improvements, including prioritization of work with identified native red-band rainbow trout habitat, and/or other focal species strongholds. **Strategy e:** Decommission roads wherever possible and develop road abandonment plans for federal, state and Tribal lands to reduce road densities and meet appropriate water quality standards.	
(10) Restore connectivity of salmonid habitat as appropriate by 2015. **Subbasin Objective 1B1**	**Strategy a:** Develop and utilize consistent barrier criteria and inventory methodology to be used province wide by agencies/managers. **Strategy b:** Inventory and prioritize all fish passage barriers by 2006. **Strategy c:** Remove artificial migration barriers as to allow fish passage where prudent to increase habitat quantity for migratory fish species. **Strategy d*:** Develop minimum in-stream flow recommendations for fish bearing streams that meet the biological requirements of salmonid fishes, including focal species. **Strategy e:** Develop technical and policy working groups (for example, Lake Roosevelt Fisheries Evaluation Program) that meet regularly to identify problems and implement solutions.	Fish passage barriers
(11) Improve or maintain streambed embeddedness between 20% and 30% in all streams with known salmonid populations. **Subbasin Objective 1B5**	**Strategy a:** Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species. **Strategy b:** Limit livestock in riparian areas and	Sedimentation

Objectives in Priority Order	Strategies in Priority Order	Limiting Factor(s) Addressed
	replant native riparian plants where needed. **Strategy c:** Decommission roads wherever possible and develop road abandonment plans for federal, state and Tribal lands to reduce road densities and meet appropriate water quality standards. **Strategy d:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions.	
(12) Maintain and/or achieve stream temperatures below 18^{o}C for all streams that support salmonid populations. **Subbasin Objective 1B3**	**Strategy a:** Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species. **Strategy b:** Develop or utilize programs that put water into streams (i.e., placing water rights into trust). **Strategy c:** Limit livestock in riparian areas and replant native riparian plants where needed. **Strategy d:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin. **Strategy e:** Restore sinuosity to channelized streams. **Strategy f:** Remove small dams as appropriate. **Strategy g:** Develop minimum in-stream flow recommendations for fish bearing streams that meet the biological requirements of salmonid fishes, including subbasin identified focal species.	Water temperature
(13) Expand stable littoral zones along Lake Roosevelt by 10% of lake surface area (at elevation 1,290 ft) **Subbasin Objective 1A2**	**Strategy a:** Use vegetation enhancements, annual seeding and water retention in backwater areas to increase near-shore fish production, increase shoreline stability, and reduce erosion. **Strategy b:** Increase water retention time in reservoirs to increase zooplankton production and reduce entrainment of juveniles. **Strategy c:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions. **Strategy d:** Modify dam operation.	Productivity, rearing habitat in Lake Roosevelt

Objectives in Priority Order	Strategies in Priority Order	Limiting Factor(s) Addressed
(14) Assess and implement nutrient enrichment program for Lake Roosevelt and tributaries. **Subbasin Objective 1A3**	**Strategy a:** Assess feasibility and potential effectiveness of nutrient enrichment in Lake Roosevelt and tributaries. **Strategy b:** Use vegetation enhancements, annual seeding and water retention in backwater areas to increase near-shore fish production, increase shoreline stability, and reduce erosion. **Strategy c:** Return nutrients lost through the extirpation of salmon stocks consistent with prudent disease and fish health practices and applicable water quality standards. **Strategy d:** Increase water retention time in reservoirs to increase zooplankton production and reduce entrainment of juveniles. **Strategy e:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.	Loss of anadromous life history, nutrients
(15) Protect, maintain, and enhance flows appropriate for all life stages of focal and native fish species in all intermittent, ephemeral, and perennial streams. **Subbasin Objective 1B8**	**Strategy a:** Implement reclamation, reuse, conservation, storage, and ground and surface water recharge. **Strategy b:** Ensure all water rights are defined and enforced. **Strategy c*:** Develop minimum in-stream flow and target flow recommendations for fish-bearing streams, that meet the biological requirements of salmonid fishes, including subbasin identified focal species. **Strategy d:** Improve enforcement of environmental regulations.	In-stream flows
(16) Attain total dissolved gases (TDG) below 110% saturation for the mainstem Columbia River. **Subbasin Objective 1A4**	**Strategy a:** Participate in technical and policy working groups (for example, TDG and TMDL groups) to develop changes in hydrosystem operations and/or physical attributes of dams to reduce TDG.	Water quality degradation
(17) Evaluate heavy metal/organic/inorganic contamination as a limiting factor on native, culturally, and economically important species. **Subbasin Objective 1B4***	**Strategy a*:** Conduct the evaluation. **Strategy b:** Implement the assessment recommendations.	Water quality degradation, sedimentation
(18) Reduce width to depth ratios to < 10 for all streams within the Subbasin, as appropriate. **Subbasin Objective 1B7**	**Strategy a:** Reduce stream bank disturbances from agriculture and recreational practices.	Stream channel instability

Objectives in Priority Order	Strategies in Priority Order	Limiting Factor(s) Addressed
	Strategy b: Conduct riparian habitat restoration, reduce fine sediment inputs, and increase channel complexity to address known limiting factors for salmonid species. **Strategy c:** Limit livestock from riparian areas and replant native riparian plants where needed. **Strategy d:** Utilize or create, where needed, incentive programs for private landowners to implement strategies to achieve this objective. **Strategy e*:** Develop criteria for prioritizing streams and/or stream reaches within the Subbasin for habitat improvements, including prioritization of work with identified native red-band rainbow trout habitat, and/or other focal species strongholds. **Strategy f:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin. **Strategy g:** Decommission roads wherever possible and develop road abandonment plans for federal, state and Tribal lands to reduce road densities and meet appropriate water quality standards.	

* = Objectives and strategies that are included in the RM&E plan.

34.3.1 Discussion of Aquatic Prioritization

The Upper Columbia Subbasin Work Team ranked the aquatic objectives with the idea that the more broad and general objectives would be ranked as top priority, with more specific objectives ranked lower. The top priority objective is a broad, overarching objective to address habitat limiting factors. As described above, the Upper Columbia Subbasin has experienced a wide array of habitat problems in the mainstem Columbia River (Lake Roosevelt) and tributary streams. This objective would cover a variety of habitat improvement projects that may be needed in the Upper Columbia Subbasin. This priority is in alignment with the Council's 2000 Fish and Wildlife Program which is "a habitat-based program, rebuilding healthy, naturally producing fish and wildlife populations by protecting, mitigating, and restoring habitats and the biological systems within them, including anadromous fish migration corridors."

The second priority for the Upper Columbia Subbasin is to protect the genetic integrity of all focal and native fish species in the Subbasin. The Subbasin Work Team felt knowing the genetic make-up of the native and focal species was key to undertaking appropriate fisheries management in the Subbasin. Some areas of the Subbasin have completed their genetic surveys and are ready to begin other types of projects. However, for those parts of the Subbasin where the fish population genetics remains relatively unknown, this is an important research need.

The third priority is another broad, overarching objective to maintain, restore, and enhance wild populations of native fish and subsistence species to provide a harvestable surplus. This objective was ranked highly because it is general enough to allow for a wide array of beneficial projects to be implemented to meet the objective. The emphasis on native fish follows the guidance in the Council's 2000 Fish and Wildlife Plan, which says that, "Even in degraded or altered environments, native species in native habitats provide the best starting point and direction for needed biological conditions in most cases. Where a species native to that particular habitat cannot be restored, then another species native to the Columbia River Basin should be used. Any proposal to produce or release nonnative species must overcome this strong presumption in favor of native species and habitats and be designed to avoid adverse impacts on native species."

The fourth priority is the restoration of resident fish using artificial production. The sixth priority is to artificially produce enough fish to supplement consistent harvest. These objectives are a necessity in this Subbasin because of the large-scale habitat destruction that has taken place, particularly as a result of Grand Coulee Dam. The Council's 2000 Fish and Wildlife Program acknowledges that, "there is an obligation to provide fish and wildlife mitigation where habitat has been permanently lost due to hydroelectric development. Artificial production of fish may be used to replace capacity, bolster productivity, and alleviate harvest pressure on weak, naturally spawning resident and anadromous fish populations." In addition, the Council's program states, "Harvest can provide significant cultural and economic benefits to the region, and the program should seek to increase harvest opportunities consistent with sound biological management practices."

The fifth priority entails bull trout surveys. Bull trout are important because they are a federally-listed threatened species, but they are rare in the Upper Columbia Subbasin. It is unlikely that this Subbasin will be a significant contributor to bull trout recovery in the Columbia River basin as a whole. However, studies are needed to determine if re-introduction of bull trout is useful or feasible.

Evaluating the feasibility of anadromous fish re-introduction was ranked in the middle of the list (eighth). While this is an important objective, it was recognized by the Work Team that anadromous fish first need to be passed over Chief Joseph Dam. Fish passage at Grand Coulee Dam may not be immediately feasible, but should be pursued.

Objectives that ranked 8 to 18 address specific limiting factors. They are ranked in order of importance in this subbasin.

34.4 Terrestrial Objectives and Strategies

The subbasin objectives and strategies are prioritized. Strategies are listed in priority order. The ranking of the objectives are given in parenthesis after the objective. Objectives and strategies also included in the research, monitoring, and evaluation plan are marked with an asterisk.

Columbia River Basin Level Category 1:

A primary overarching objective of the Columbia River Basin 2000 Fish and Wildlife Program is the completion of mitigation for the adverse effects to wildlife caused by the development and operation of the hydrosystem.

Provincial Priority 1: **Columbia River Basin Level Goal 1A:**
Complete the current Wildlife Mitigation Program for construction and inundation losses of federal hydrosystem as identified in Appendix C, Table 11-4 of the Columbia River Basin 2000 Fish and Wildlife Program.

> **Province Level Objective 1A**:
> Fully mitigate for construction and inundation losses incurred from the Chief Joseph Dam, Grand Coulee Dam, and Albeni Falls projects per the requirements of the Northwest Power Act and the current Wildlife Mitigation Program (Appendix C, Table 11-4 of the Columbia River Basin 2000 Fish and Wildlife Program) by 2015. This includes developing and implementing projects within the IMP that protect, enhance, or restore Habitat Units for HEP evaluation species and habitats as specified in the construction loss assessments for Chief Joseph, Grand Coulee, and Albeni Falls dams (Kuehn and Berger 1992; Creveling and Renfrow 1986; Martin et al. 1988); coordinated planning; provision of adequate funding for long-term Operations and Maintenance (O&M); and effectiveness monitoring of projects.
>
> > **Upper Columbia Subbasin Objective 1A**: Fully mitigate for terrestrial resource losses incurred from construction and inundation of the Grand Coulee Project per the requirements of the Northwest Power Act. Complete the compensation mitigation for construction losses at Grand Coulee Dam

for wildlife and wildlife habitat consistent with the HEP loss assessment (Appendix C, Table 11-4 of the Columbia River Basin 2000 Fish and Wildlife Program) by year 2015. (These requirements will be met in coordination with San Poil and Upper Columbia subbasins, which also are influenced by Lake Roosevelt). (Priority 1)

All of the following objectives that are associated with Subbasin Objective 1A are of equally high priority:

Objective 1A1: Protect, enhance, or restore secure riverine island Canada goose nest sites to address riverine island/bar habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A2: Protect enhance, or restore mourning dove Habitat Units to address riparian and agricultural habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A3: Protect, enhance, or restore mule deer Habitat Units to address shrub-steppe and river break habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A4: Protect, enhance, or restore riparian forest Habitat Units to address habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A5: Protect, enhance, or restore riparian shrub Habitat Units to address habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A6: Protect, enhance, or restore ruffed grouse Habitat Units to address riparian/hardwood forest habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A7: Protect, enhance, or restore sage grouse Habitat Units to address shrub-steppe habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A8: Protect, enhance, or restore sharp-tailed grouse Habitat Units to address grasslands, shrub-steppe, and riparian draw habitat losses resulting from construction of the Grand Coulee Project.

Objective 1A9: Protect, enhance, or restore white-tailed deer Habitat Units to address seral forest habitat losses resulting from construction of the Grand Coulee Project.

Strategies for 1A1 through 1A9, in priority order:

Strategy a: Maintain wildlife habitat values (Habitat Units) on existing and newly acquired mitigation lands for the life of the project through adequate long-term Operations and Maintenance (O&M) funding.

Strategy b: Protect habitat through fee title acquisition, conservation easements, lease, or management plans that address road closure, livestock, soil, vegetation and unwanted species, fire and fuels, nonnative wildlife, etc.

Strategy c*: Evaluate effectiveness of mitigation by monitoring and evaluating species and habitat responses to mitigation actions.

Provincial Priority 2: **Columbia River Basin Level Goal 1B:**
Quantify the operational effects of federal hydrosystem projects on terrestrial resources, develop mitigation plan in coordination with other resource mitigation and resource planning efforts, and implement projects to mitigate the impacts, including maintenance and monitoring.

Province Level Objective 1B:
Quantitatively assess and mitigate operational impacts of the Chief Joseph Dam, Grand Coulee Dam, and Albeni Falls projects per the requirements of the Northwest Power Act and the current Wildlife Mitigation Program. Complete assessment of operational impacts by 2008; develop mitigation plan by 2010; implement initial mitigation by 2015; incorporate formal methods for review and update of effects assessment and mitigation plan on a three-year cycle to respond to changes in operation and to effectiveness of mitigation actions.

Subbasin Objective 1B*: Quantitatively assess operational impacts of the Grand Coulee Project on terrestrial resources by year 2008.

Objective 1B1*: Quantitatively assess operational impacts of the Grand Coulee Project on terrestrial resources by year 2008. (Priority 2)

Strategy a*: Have an impartial third party contractor conduct the assessment, including but not limited to: fluctuation zone, loss of nutrients in watershed from loss of salmon, recreational effects to terrestrial resources, BPA transmission lines, connectivity, and erosion, etc.

Objective 1B2: Develop mitigation plan by year 2010 and implement initial mitigation by year 2015. (Priority 3)

Strategy a: Develop the mitigation plan.

Strategy b: Implement the mitigation plan.

Columbia River Basin Level Category 2:

In consideration of the primary overarching objectives of the Columbia River Basin 2000 Fish and Wildlife Program, provide: 1) sufficient populations of wildlife for abundant opportunities for Tribal trust and treaty right harvest and for non-Tribal harvest; 2) recovery of wildlife species affected by the development and operation of the hydrosystem that are listed under the Endangered Species Act; and 3) a Columbia River ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife.

Provincial Priority 3: **Columbia River Basin Level Goal 2**:
Mitigate for wildlife losses that have occurred through secondary effects of hydrosystem development, including assessment, development of mitigation plan in coordination with other resources and resource managers, implementation, maintenance, and monitoring.

Province Level Objective 2A:
Mitigate for wildlife losses that have occurred through secondary effects of hydrosystem development by protecting, enhancing, restoring, and sustaining populations of wildlife for aesthetic, cultural, ecological, and recreational values. Objective includes assessment of secondary impacts, development of mitigation plan in coordination with other resources and resource managers, implementation, maintenance, and monitoring. Because the secondary effects of hydrosystem development are tightly intermingled with the effects of other activities in the province, this objective also incorporates other actions to maintain or enhance populations of federal, state, and Tribal species of special concern, and other native and desirable nonnative wildlife species, within their present and/or historical ranges in order to prevent future declines and restore populations that have suffered declines or been extirpated.

Objective 2A1: Maintain bald eagle at or above present levels (2004) in the Upper Columbia Subbasin. (Priority 5)

Strategy a: Maintain secure bald eagle breeding and wintering habitats.

Strategy b*: Identify and map current or potential winter perching and foraging habitat.

Strategy c*: Continue or increase monitoring of nesting and wintering bald eagles.

Objective 2A2: Increase sharp-tailed grouse populations within the Intermountain Province and associated subbasins to a minimum of 800 grouse by 2010; over the long-term, improve and maintain the habitats necessary to support self-sustaining, persistent populations of grouse, estimated to consist of a minimum of 2,000 birds. (This objective shared with Lake Rufus Woods, San Poil, and Spokane subbasins.) (Priority 4)

Strategy a*: Assess and determine limiting factors on sharp-tailed grouse populations within the IMP and associated subbasins by 2006.

Strategy b: Develop, prioritize, and implement projects and/or research to address identified sharp-tailed grouse limiting factors.

Strategy c*: Assess and, if deemed needed, limit/restrict nonnative invasive species interaction/competition and habitat degradation.

Objective 2A3: Increase blue-grouse populations by 20 percent in the Upper Columbia and adjacent subbasins/provinces by year 2010. (Priority 9)

Strategy a*: Assess and determine specific factors limiting/affecting blue-grouse populations in the Upper Columbia Subbasin and adjacent subbasins/provinces by year 2006.

Strategy b: Develop, prioritize, and implement projects and/or research to address identified blue-grouse limiting factors by year 2008.

Strategy c: Utilize fire, fire sequence, forest management, or other techniques to enhance, restore, or maintain large blocks of mature, closed canopy ponderosa pine and western larch.

Objective 2A4: Maintain or increase golden eagle populations to at, or above, 2004 levels. (Priority 8)

Strategy a*: Determine limiting factors for golden eagles by 2006.

Strategy b: Develop, prioritize, and implement projects and/or research to address identified limiting factors for golden eagles by 2007.

Province Level Objective 2B:
Mitigate for wildlife losses that have occurred through secondary effects of hydrosystem development by protecting, enhancing, restoring, and sustaining native wildlife habitat function to maintain or enhance ecological diversity and security for native and desirable nonnative wildlife species. Objective includes assessment of secondary impacts, development of mitigation plan in coordination with other resources and resource managers, implementation, maintenance, and monitoring. Because the secondary effects of hydrosystem development are tightly intermingled with the effects of other activities in the province, this objective also incorporates other actions to identify, maintain, restore, and enhance priority habitats (wetlands, riparian areas, upland forests, steppe and shrub-steppe, cliffs and rock outcrops, caves, grasslands, and other priority habitats) including their

structural attributes, ecological functions, and distribution and connectivity across the landscape to optimize conditions required to increase overall wildlife productivity of desired species assemblages. Strategies may include land acquisition, conservation easements, management contracts, and/or partnerships with other landowners.

Province Level Objective 2B1: Identify and implement strategies and opportunities for restoring the diversity, block size, and spatial arrangement of habitat types needed to sustain target wildlife species at ecologically sound levels.

Province Level Objective 2B2: Restore the connectivity of habitat types needed to sustain wildlife populations at the landscape level. Encourage and support the implementation of all forest practices, including road building and maintenance, as specified in the Washington Department of Natural Resources and Idaho Department of Lands Forest Practices Rules and subbasin Forest Plans for all National Forests within the Subbasin.

> **Objective 2B1***: Identify, maintain, restore, and enhance priority habitats (wetlands, riparian areas, upland forests, steppe and shrub-steppe, cliffs and rock outcrops, caves, grasslands, and other priority habitats) within the Upper Columbia Subbasin, including their structural attributes, ecological functions, and distribution and connectivity across the landscape to optimize conditions required to increase overall wildlife productivity of desired species assemblages. Strategies may include land acquisition, conservation easements, management contracts, and/or partnerships with other landowners. (Priority 7)
>
> > **Strategy a:** Protect, restore, and provide connectivity of riparian habitat and cottonwood galleries.
> >
> > **Strategy b:** Utilize prescribed fire, forest management, or other applicable techniques to enhance, restore, and/or maintain large blocks of mature stands of Ponderosa pine and western larch.
> >
> > **Strategy c:** Eliminate or reduce undesirable invasive vegetation.
> >
> > **Strategy d:** Provide incentive program for private landowners to actively manage specific habitats to accomplish Objective 2B1.
> >
> > **Strategy e:** Acquire land through purchase or utilize conservation easements to protect key habitats.
> >
> > **Strategy f:** Limit livestock in riparian areas and replant native riparian plants where needed.
> >
> > **Strategy g**: Ensure protection of rock/cliff/talus/cave habitat through conservation easement, management plans, etc.

Strategy h: Maintain forest shrubs, forbs, grasses, and saplings to provide foraging habitat in spring, summer and fall on key habitat areas.

Strategy i: Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.

Objective 2B2: Increase quantity and quality of mule deer habitats, particularly winter and spring ranges. (Priority 6)

Strategy a: Secure, protect, and enhance winter and spring ranges.

Strategy b: Restore grasses and forbs where noxious weeds have impacted mule deer habitat.

Strategy c: Manage forests for a variety of successional stages to meet mule deer habitat needs on a site-specific basis; use fire and forest management to increase quality and quantity of shrubs and mature forest cover.

Strategy d: Identify specific factors limiting/affecting mule deer populations in the Upper Columbia Subbasin.

Strategy e: Increase the area of aspen stands.

Strategy f: Manage motorized traffic in critical mule deer spring and winter ranges.

Strategy g: Improve enforcement of applicable regulations.

34.4.1 Prioritization of Terrestrial Objectives and Strategies

A detailed discussion of the methods used to prioritize the objectives and strategies is found in Section 1.2. In Upper Columbia Subbasin, the members of the Subbasin Work Team contributed to the development of ranking criteria which were based largely on the criteria in the Council's 2000 Fish and Wildlife Program. The ranking criteria were finalized by the IMP OC, but each Work Team was offered the option of adding additional subbasin specific criteria to the ranking. They recommended that a new subbasin specific criterion be added for the terrestrial that would increase the priority of objectives that are mandated by the Northwest Power Act. Following discussion, the Work Team decided to add the following subbasin specific criteria:

- Terrestrial subbasin specific criteria – Is the objective/strategy mandated by the Northwest Power Act?

The Work Team rated the criteria for each objective from one to ten. An average ranking

was calculated for each respondent for each objective, and then an overall Work Team average was calculated. Strategies were rated high, medium and low. These categories were converted to numeric values: 3, 2, and 1 respectively. The average ranking for each strategy was calculated for each respondent and for the Work Team as a whole.

The Work Team discussed the preliminary prioritization results for the objectives and strategies at the sixth Work Team meeting, and based on a consensus decision agreed to the final prioritization of the objectives and strategies.

The final prioritization of the terrestrial objectives and strategies for the Upper Columbia Subbasin is displayed in Table 34.4-1.

Table 34.4-1. Ranking of terrestrial objectives and strategies in the Upper Columbia Subbasin, with the limiting factor(s) that the objective was designed to address.

Objectives in priority order	Strategies	Limiting Factor(s) Addressed
Provincial Priority 1 – Mitigate for construction and inundation losses		
(1) Fully mitigate for terrestrial resource losses incurred from construction and inundation of the Grand Coulee Project per the requirements of the Northwest Power Act. Complete the compensation mitigation for construction losses at Grand Coulee Dam for wildlife and wildlife habitat consistent with the HEP loss assessment (Appendix C, Table 11-4 of the Columbia River Basin 2000 Fish and Wildlife Program) by year 2015. (These requirements will be met in coordination with San Poil and Upper Columbia subbasins, which also are influenced by Lake Roosevelt). **Objective 1A** **Sub-objectives listed below are all of equal priority.** **Objective 1A1:** Protect, enhance, or restore secure riverine island Canada goose nest sites to address riverine island/bar habitat losses resulting from construction of the Grand Coulee Project. **Objective 1A2:** Protect enhance, or restore mourning dove Habitat Units to address riparian and agricultural habitat losses resulting from construction of the Grand Coulee Project. **Objective 1A3:** Protect, enhance, or restore mule deer Habitat Units to address shrub-steppe and river break habitat losses resulting from construction of the Grand Coulee Project. **Objective 1A4:** Protect, enhance, or restore riparian forest Habitat Units to address habitat losses resulting from construction of the Grand Coulee Project. **Objective 1A5:** Protect, enhance, or restore riparian shrub Habitat Units to address habitat losses resulting from construction of the Grand Coulee Project **Objective 1A6:** Protect, enhance, or restore ruffed grouse Habitat Units to address riparian/hardwood forest habitat losses resulting from construction of the Grand Coulee Project. **Objective 1A7:** Protect, enhance, or restore sage grouse Habitat Units to address shrub-steppe habitat losses resulting	**Strategy a:** Maintain wildlife habitat values (Habitat Units) on existing and newly acquired mitigation lands for the life of the project through adequate long-term Operations and Maintenance (O&M) funding. **Strategy b:** Protect habitat through fee title acquisition, conservation easements, lease, or management plans that address road closure, livestock, soil, vegetation and unwanted species, fire and fuels, nonnative wildlife, etc. **Strategy c*:** Evaluate effectiveness of mitigation by monitoring and evaluating species and habitat responses to mitigation actions.	Terrestrial resource losses incurred from construction and inundation of the Grand Coulee Project

Objectives in priority order	Strategies	Limiting Factor(s) Addressed
from construction of the Grand Coulee Project. **Objective 1A8:** Protect, enhance, or restore sharp-tailed grouse Habitat Units to address grasslands, shrub-steppe, and riparian draw habitat losses resulting from construction of the Grand Coulee Project. **Objective 1A9**: Protect, enhance, or restore white-tailed deer Habitat Units to address seral forest habitat losses resulting from construction of the Grand Coulee Project.		
Provincial Priority 2 – Quantify and mitigate for operational impacts		
(2) Quantitatively assess operational impacts of the Grand Coulee Project on terrestrial resources by year 2008. **Objective 1B1***	**Strategy a*:** Have an impartial third party contractor conduct the assessment, including but not limited to: fluctuation zone, loss of nutrients in watershed from loss of salmon, recreational effects to terrestrial resources, BPA transmission lines, connectivity, and erosion, etc.	Lack of data on operational impacts
(3) Develop mitigation plan by year 2010 and implement initial mitigation by year 2015. **Objective 1B2**	**Strategy a**: Develop the mitigation plan. **Strategy b:** Implement the mitigation plan.	Need to mitigate operational impacts
Provincial Priority 3 – Mitigate for secondary effects of FCRPS and other subbasin effects		
(4) Increase sharp-tailed grouse populations within the Intermountain Province and associated subbasins to a minimum of 800 grouse by 2010; over the long-term, improve and maintain the habitats necessary to support self-sustaining, persistent populations of grouse, estimated to consist of a minimum of 2,000 birds. (This objective shared with Lake Rufus Woods, San Poil, and Spokane subbasins.) **Objective 2A2**	**Strategy a*:** Assess and determine limiting factors on sharp-tailed grouse populations within the IMP and associated subbasins by 2006. **Strategy b:** Develop, prioritize, and implement projects and/or research to address identified sharp-tailed grouse limiting factors. **Strategy c*:** Assess and, if deemed needed, limit/restrict nonnative invasive species interaction/competition and habitat degradation.	Secondary effects of FCRPS and other subbasin effects to sharp-tailed grouse populations
(5) Maintain bald eagle at or above present levels (2004) in the Upper Columbia Subbasin. **Objective 2A1**	**Strategy a:** Maintain secure bald eagle breeding and wintering habitats. **Strategy b*:** Identify and map current or potential winter perching and foraging habitat.	Secondary effects of FCRPS and other subbasin effects to bald eagles

Objectives in priority order	Strategies	Limiting Factor(s) Addressed
	Strategy c*: Continue or increase monitoring of nesting and wintering bald eagles.	
(6) Increase quantity and quality of mule deer habitats, particularly winter and spring ranges. **Objective 2C2**	**Strategy a:** Secure, protect, and enhance winter and spring ranges. **Strategy b:** Restore grasses and forbs where noxious weeds have impacted mule deer habitat. **Strategy c:** Manage forests for a variety of successional stages to meet mule deer habitat needs on a site-specific basis; use fire and forest management to increase quality and quantity of shrubs and mature forest cover. **Strategy d:** Identify specific factors limiting/affecting mule deer populations in the Upper Columbia Subbasin. **Strategy e:** Increase the area of aspen stands. **Strategy f:** Manage motorized traffic in critical mule deer spring and winter ranges. **Strategy g:** Improve enforcement of applicable regulations.	Secondary effects of FCRPS and other subbasin effects to mule deer habitats
(7) Identify, maintain, restore, and enhance priority habitats (wetlands, riparian areas, upland forests, steppe and shrub-steppe, cliffs and rock outcrops, caves, grasslands, and other priority habitats) within the Upper Columbia Subbasin, including their structural attributes, ecological functions, and distribution and connectivity across the landscape to optimize conditions required to increase overall wildlife productivity of desired species assemblages. Strategies may include land acquisition, conservation easements, management contracts, and/or partnerships with other landowners. **Objective 2C1***	**Strategy a:** Protect, restore, and provide connectivity of riparian habitat and cottonwood galleries. **Strategy b:** Utilize prescribed fire, forest management, or other applicable techniques to enhance, restore, and/or maintain large blocks of mature stands of Ponderosa pine and western larch. **Strategy c:** Eliminate or reduce undesirable invasive vegetation.	Secondary effects of FCRPS and other subbasin effects to priority habitats

Objectives in priority order	Strategies	Limiting Factor(s) Addressed
	Strategy d: Provide incentive program for private landowners to actively manage specific habitats to accomplish objective 2B1. **Strategy e:** Acquire land through purchase or utilize conservation easements to protect key habitats. **Strategy f:** Limit livestock in riparian areas and replant native riparian plants where needed. **Strategy g**: Ensure protection of rock/cliff/talus/cave habitat through conservation easement, management plans, etc. **Strategy h**: Maintain forest shrubs, forbs, grasses, and saplings to provide foraging habitat in spring, summer and fall on key habitat areas. **Strategy i:** Develop technical and policy working groups that meet regularly to identify problems and implement solutions for the Upper Columbia Subbasin.	
(8) Maintain or increase golden eagle populations to at, or above, 2004 levels. **Objective 2A4**	**Strategy a*:** Determine limiting factors for golden eagles by 2006. **Strategy b:** Develop, prioritize, and implement projects and/or research to address identified limiting factors for golden eagles by 2007.	Secondary effects of FCRPS and other subbasin effects to golden eagles
(9) Increase blue-grouse populations by 20% in the Upper Columbia and adjacent subbasins/provinces by year 2010. **Objective 2A3**	**Strategy a*:** Assess and determine specific factors limiting/affecting blue-grouse populations in the Upper Columbia Subbasin and adjacent subbasins/provinces by year 2006. **Strategy b:** Develop, prioritize, and implement projects and/or research to address identified	Secondary effects of FCRPS and other subbasin effects to blue grouse populations

Objectives in priority order	Strategies	Limiting Factor(s) Addressed
	blue-grouse limiting factors by year 2008. **Strategy c:** Utilize fire, fire sequence, forest management, or other techniques to enhance, restore, or maintain large blocks of mature, closed canopy ponderosa pine and western larch.	

* = Objectives and strategies that are included in the RM&E plan.

34.4.2 Discussion of Terrestrial Prioritization

The ranking of the terrestrial objectives directly reflects the priorities established in the Council's 2000 Fish and Wildlife Program. The overall top priority terrestrial objective for the Upper Columbia Subbasin is to fully mitigate for terrestrial resource losses incurred from construction and inundation of the Grand Coulee Project per the requirements of the Northwest Power Act. Within this objective, there are nine sub-objectives that have not been prioritized. All the sub-objectives are considered to be of equal importance.

The next level of priority is quantifying and mitigating for the operational impacts of the FCRPS per the requirements of the Northwest Power Act. In the Upper Columbia Subbasin, no assessment of operational impacts has been conducted. Therefore, this is the first priority in this category of objectives. Once the impacts have been identified, the next priority will be to develop a mitigation plan by 2010 and to implement the mitigation plan by 2015.

The third priority in the IMP is to mitigate for secondary effects of the hydrosystem development in combination with other subbasin effects to terrestrial resources. In this category of objectives, the Upper Columbia Subbasin Work Team ranked increasing sharp-tailed grouse as the highest priority. Bald eagles, as a federally-listed threatened species, are the next priority. Mitigating for secondary losses and subbasin effects to mule deer habitat is the next priority as there are considerable concerns about mule deer in this Subbasin. Mitigating for secondary losses to priority habitats, golden eagles and blue grouse populations are the next priority.

SECTION 35 – Table of Contents

35 Upper Columbia Research, Monitoring and Evaluation Plan

In light of the various ongoing efforts to develop a regional monitoring plan, subbasin planners the Intermountain Province (IMP) have chosen to develop a monitoring plan based on existing monitoring methods described in the scientific literature. The IMP approach to the Research, Monitoring and Evaluation (RM&E) is as follows:

- Research is handled separately from the M&E design. A wish list of research needs is identified based on the biological objectives, strategies and critical uncertainties identified in the subbasin management plans and subbasin assessments. Many of the subbasin work teams developed preliminary research needs lists. Although there is an extensive "wish list" of research questions in the IMP, the limitations of available funding made it important to prioritize the research questions into two categories: "need to know" and "would like to know."

- For the M&E component, subbasin planners in the IMP developed a framework to link specific objectives and strategies identified in the IMP subbasin management plans to a suite of M&E protocols and existing programs (an M&E "tool box"). To do this a subcommittee of the OC identified a broad list of existing M&E protocols and existing M&E programs, which represent: peer reviewed, scientifically validated approaches to M&E; are appropriate to range of geographic scales; and, include the range of the Independent Science Review Panel's (ISRP) three tiers of RM&E. Specific M&E objectives and strategies from each of the subbasin management plans, and from the province level, were then linked in Table 35.1 to:

    - The type of generic approach to addressing limiting factors that is addressed by the strategy or objective (same list used to categorize the inventory of projects)
    - The type of M&E protocol that would be most appropriate
    - Which ISRP M&E tier level of RM&E would be appropriate
    - Which of the "tool box" tools would be used.

The complete tool box bibliography is found in Appendix I. More detailed information on the process for developing the RM&E plan is found in Section 2.

Table 35.1. Upper Columbia Subbasin research, monitoring, and evaluation plan

AQUATIC					
Strategy & Objective	**Strategy Type[1]**	**Monitoring Type[2]**	**Tier[3]**	**Scale[4]**	**Tool Box Tool[5]**
Columbia Basin Goal 1A: Subbasin Objective 1A1: Assess resident fish losses resulting from the hydrosystem. (Continue to evaluate hydropower impacts to native and focal species.)	1, 2, 3, 4, 5, 9, 10	?	2	1, 2, 3	1, 3, 4, 6, 8, 11, 12, 14, 17, 22, 26, 28, 36, 37
Subbasin Objective 1A1 Strategy a: Develop and implement plans to reduce hydropower impacts to native and focal species	1, 2, 3, 4, 5, 9, 10	Population, Habitat Surveys	1, 3	1, 2, 3	1, 3, 4, 5, 6, 8, 12, 17, 18, 22, 36, 37
Subbasin Objective 1A1 Strategy c: Monitor entrainment.	2, 10	?	1, 3	1, 2	17, 22
Subbasin Objective 1A3: Assess nutrient availability and feasibility of enrichment programs for Lake Roosevelt and tributaries.	1, 5, 6, 10	Water Quality Surveys	3	1, 2, 3	4, 5, 6, 9, 10, 16, 17, 22, 36, 37
Province Level Objective 1B: Assess chemical, biological, and physical factors influencing aquatic productivity. (To allow managers to maintain functional ecosystems for resident fish through protection and restoration of in-stream and riparian habitats) Includes, but is not limited to, in-stream connectivity, habitat condition, stream/reservoir temperature, streambed embeddedness, riparian habitat condition, width to depth ratios and flows.	1, 2, 3, 4, 5, 6, 9, 10	Holistic ecosystem monitoring (i.e. All)	1, 2, 3	1, 2, 3, 4	1, 3, 4, 5, 6, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 36, 37
Subbasin Objective 1B1: Assess connectivity.	1, 2, 3, 4, 5, 6, 9, 10	Mapping, Surveys, Genetics	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10 . . .
Subbasin Objective 1B2: Assess habitats.	1, 3, 4, 5, 6, 10	Population, Habitat Surveys	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10 . . .
Subbasin Objective 1B3: Assess Stream/Reservoir Temperature.	1, 3, 5, 6, 10	Water Quality Surveys	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10 . . .
Subbasin Objective 1B4 Strategy a: Evaluate heavy metal/organic/inorganic contamination as a limiting factor on native, culturally, and economically important species.	1, 2, 5	Water Quality, Population & Toxicity Surveys	1, 2, 3	1, 2, 3	5, 9, 10
Subbasin Objective 1B5: Assess streambed embeddedness.	1, 5	Mapping, Habitat Surveys	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10 . . .
Subbasin Objective 1B6: Assess riparian habitats.	1, 6, 10	Mapping, Habitat Surveys	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10 . . .
Subbasin Objective 1B7: Assess width to depth ratios.	1, 3, 4, 5, 6, 10	Mapping, Habitat Surveys	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10 . . .

AQUATIC					
Strategy & Objective	**Strategy Type[1]**	**Monitoring Type[2]**	**Tier[3]**	**Scale[4]**	**Tool Box Tool[5]**
Subbasin Objective 1B6 & 1B7 Strategy e: Develop criteria for prioritizing streams and/or stream reaches within the subbasin for habitat improvements, including prioritization of work with identified native red-band rainbow trout habitat, and/or other focal species strongholds.	1, 2, 3, 4, 5, 6, 9	?	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10, 14, 15, 16, 17, 18, 19, 20, 21, 23, 25, 26, 28
Subbasin Objective 1B8: Assess flows.	1, 3, 4, 5, 10	Flow Surveys	1, 2, 3	1, 2, 3	1, 4, 5, 6, 9, 10 . . .
Subbasin Objective 1B1 & 1B8 Strategy e: Develop minimum in-stream flow recommendations for fish bearing streams that meet the biological requirements of salmonid fishes, including focal species.	1, 2, 3, 4, 5, 9, 10	?	1	1, 2, 3	1, 4, 5, 6, 9, 10, 14, 15, 16, 18, 19, 20, 21, 23, 25, 26, 28
Subbasin Objective 1C1 Strategy a: Conduct ESA listed species distribution and habitat suitability surveys (Bull Trout).	1, 2, 4, 5, 6, 9	Mapping, Population/Habitat Surveys, Genetics	2	1, 2, 3, 4	4, 5, 6, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 25, 26, 27, 28
Subbasin Objective 2A1 Strategy a: Determine genetic distribution of native focal species (white sturgeon, rainbow/redband trout, Pacific lamprey, burbot, kokanee), identify limiting factors, and develop strategies for addressing limiting factors by 2006.	1, 2, 3, 4, 5, 6, 8, 9, 10	Mapping, Population/Habitat Surveys, Genetics	2, 3	1, 2, 3, 4	1, 4, 5, 6, 7, 8, 12, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28
Subbasin Objective 2A2: Assess population status of wild native fish and subsistence species.	2, 9	Mapping, Population/Habitat Surveys, Genetics	2, 3	1, 2, 3, 4	1, 3, 4, 5, 7, 8, 11, 12, 14, 15, 17, 22, 24, 25, 26, 28
Subbasin Objective 2C1 Strategy a: Evaluate feasibility of anadromous fish re-introduction by 2015, and begin implementation.	1, 2, 3, 4, 5, 6, 8, 9, 10	?	2, 3	1, 2, 3	1, 4, 5, 7, 11, 17, 20, 21, 26, 27, 28

AQUATIC – ADDITIONAL RESEARCH, MONITORING, AND EVALUATION NEEDS					
Strategy & Objective	**Strategy Type**	**Monitoring Type**	**Tier**	**Scale**	**Tool Box Tool**
Monitor and evaluate artificial reproduction programs and effects on resident fish and lower trophic levels.	1, 2, 3, 4, 5, 9, 10	Holistic ecosystem monitoring (i.e. All)	1, 2, 3	1, 2, 3, 4	1, 3, 4, 5, 6, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 36, 37
Monitor and evaluate nonnative effects on native fish populations (competition, predation, and introgression effects).	1, 2, 3, 4, 5, 9, 10	Population/Habitat Surveys	1, 2, 3	1, 2, 3, 4	1, 3, 4, 5, 6, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 36, 37
Assess and monitor native and nonnative resident fish stock composition, distribution, and relative abundance within the Subbasin.	1, 2, 3, 4, 5, 9, 10	Population/Habitat Surveys	1, 2, 3	1, 2, 3	1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 36, 37
Assess need for conservation aquaculture facilities.	1, 2, 5, 9	Population Surveys	2	1, 2, 3	1, 4, 5, 6, 10, 12, 14, 15, 16, 17, 19, 21, 22, 23, 24, 26, 27, 28, 36, 37
Conduct baseline assessments for fish	1, 2, 3, 4, 5, 6, 9	All	1, 2	1, 2, 3, 4	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 26, 28, 36, 37, 41, 42,
Assess effects of TDG levels on natural populations and net pen fish for Lake Roosevelt above GCD.	9, 10	TMDL, Water Quality/Fish Surveys	3	1, 2, 3	16, 17, 22, 28, 36, 37, 38
Assess TDG at fixed sites.	1, 5, 10	Water Quality Surveys	1, 3	1, 2, 3	16, 17, 22, 28, 36, 37, 38, 39, 40, 44

AQUATIC – ADDITIONAL RESEARCH, MONITORING, AND EVALUATION NEEDS					
Strategy & Objective	**Strategy Type**	**Monitoring Type**	**Tier**	**Scale**	**Tool Box Tool**
Monitor and enhance lake and stream fisheries.	1, 2, 3, 4, 5, 6, 9	Population/Habitat Surveys	1, 2	1, 2, 3	1-16, 18-28, 36, 37, 39, 40, 41, 42, 43, 44
Monitor and evaluate fish populations for downstream migration/reproductive rates including adfluvial redband trout, mountain whitefish, Chinook, and kokanee (list is not all inclusive).	1, 2, 3, 4, 5, 6, 9, 10	Population/Habitat/ Genetic and Water Quality Surveys	2, 3	1, 2, 3	1-16, 18-28, 36, 37, 39, 40, 41
Assess feasibility of developing and utilizing multilevel (adjustable depth) net pens.	9, 10	Population Surveys	3	1, 2, 3	22, 36, 37, 38, 39, 40, 41, 43, 44
Assess watersheds for habitat condition, and implement and monitor watershed improvements as identified in assessment, to address habitat and water quality conditions for native and nonnative resident fish.	1-7, 9, 10	Population/Habitat and Water Quality Surveys	1, 2, 3	1, 2, 3	1, 2, 4, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 19, 20, 21, 23, 24, 25, 26, 28, 37, 38, 39, 40, 41, 42, 43, 44
Complete bathymetry for Lake Roosevelt (including Spokane Arm).	1, 5, 10	Habitat/Water Quality	2, 3	1	1, 2,
Assess substrate composition and utilization by fish for streams/reservoirs in the Subbasin.	1, 5, 11	Habitat Survey	2, 3	1, 2	1, 2, 6, 8, 9, 10, 12, 14, 15, 20, 21, 25, 26, 28, 37, 42

[1]***Strategy types:***

1) Habitat Assessments
2) Population Assessments
3) In-stream Diversion
4) In-stream Passage
5) In-stream Habitat
6) Riparian Habitat
7) Upland Habitat
8) Education/Coordination
9) Population Management
10) Reservoir Operations

[2]***Monitoring Protocol e.g., type of monitoring protocol [note: the specific reference to detailed monitoring protocol is identified in the "tool box"]):***

- TMDL
- Survey
- Survey and mapping

- HEP
- P/A and trend surveys
- All habitat

[3]ISRP Tier Level:

1) Tier 1: trend or routine monitoring
2) Tier 2: statistical (status) monitoring
3) Tier 3: experimental research (effectiveness) monitoring

[4]Scale of Monitoring and Evaluation:

1) Project
2) Subbasin
3) Province
4) Columbia Basin

[5] Tool Box Tool

The Tool Box is found in Appendix I.

TERRESTRIAL					
Strategy & Objective	**Strategy Type[1]**	**Monitoring Type[2]**	**Tier[3]**	**Scale[4]**	**Tool Box-tool[5]**
Basin Level Goal 1A: Fully mitigate for construction and inundation losses					
Objective 1A11: M&E on wildlife lands to determine benefits of enhancements.					
Strategy a: Monitor habitat enhancement activities.	1,6,7	HEP		1	
Strategy b: Monitor wildlife population response to habitat enhancement activities.	2			1	52, 53, 54, 55, 56, 57, 58, 59
Basin Level Goal 1B: Quantify the **operational effects** of federal hydrosystem projects on terrestrial resources, develop mitigation plan in coordination with other resource mitigation and resource planning efforts, and implement projects to mitigate the impacts, including maintenance and monitoring.					
Province Level Objective 1B: Quantitatively assess and mitigate **operational impacts** of the Chief Joseph, Grand Coulee Dam, and Albeni Falls projects per the requirements of the Northwest Power Act and the current Wildlife Mitigation Program. Complete assessment of operational impacts by **2008**; develop mitigation plan by **2010**; implement initial mitigation by **2015**; incorporate formal methods for review and update of effects assessment and mitigation plan on a three-year cycle, to respond to changes in operation and to effectiveness of mitigation actions.					
Upper Columbia Subbasin Objective 1B: Quantitatively assess operational impacts of the Grand Coulee Project on terrestrial resources by year 2008.					
Objective 1B1: Quantitatively assess operational impacts of the Grand Coulee Project on terrestrial resources by year 2008.					
Strategy a: Have an impartial third party contractor conduct the assessment, including but not limited to: fluctuation zone, loss of nutrients in watershed from loss of salmon, recreational effects to terrestrial resources, BPA transmission lines, connectivity, and erosion, etc.	1, 2, 6, 7			2, 3	
Objective 2A1: Maintain bald eagle at or above present levels (2004) in the Upper Columbia Subbasin.					
Strategy b: Identify and map current or potential winter perching and foraging habitat.	1	IBIS, GAP		2, 3	

TERRESTRIAL					
Strategy & Objective	**Strategy Type[1]**	**Monitoring Type[2]**	**Tier[3]**	**Scale[4]**	**Tool Box-tool[5]**
Strategy c: Continue or increase monitoring of nesting and wintering bald eagles.	2			2, 3	59
SO 2A2: Strategy a: Determine limiting factors on sharp-tailed grouse populations within the IMP and associated subbasins by 2006.	1, 2, 6, 7	HEP		2, 3, 4	
SO 2A2: Strategy c: Assess current versus historical habitat availability and quality and if needed implement habitat restoration/conversion to address concerns.	1, 6, 7	HEP, IBIS, GIS		2,3,4	
SO 2A2: Strategy d: Assess and, if deemed needed, limit/restrict nonnative invasive species interaction/competition and habitat degradation.	1, 6, 7	HEP		1,2,3,4	
SO 2A3: Strategy a: Identify specific factors limiting/affecting blue-grouse populations in the Upper Columbia Subbasin and adjacent subbasins/provinces by year 2010.	1, 2	HEP		2,3	
SO 2A3: Strategy d: Assess current versus historical habitat availability and quality and if needed implement habitat restoration/conversion to address concerns.	1, 7	HEP, IBIS, GIS		2, 3	
SO 2A3: Strategy e: Assess, and if deemed, needed limit/restrict nonnative invasive species interaction/competition and habitat degradation.	1, 6, 7	HEP		1,2,3,4	
SO 2A4: Strategy a: Determine limiting factors for golden eagles by 2006.	1, 2			2, 3	
Objective 2B1: Identify, maintain, restore, and enhance priority habitats (wetlands, riparian areas, upland forests, steppe and shrub-steppe, cliffs and rock outcrops, caves, grasslands, and other priority habitats) within the Upper Columbia Subbasin, including their structural attributes, ecological functions, and distribution and connectivity across the landscape to optimize conditions required to increase overall wildlife productivity of desired species assemblages. Strategies may include land acquisition, conservation easements, management contracts, and/or partnerships with other landowners.					

[1] ***Strategy types:***

1) Habitat Assessments
2) Population Assessments
3) In-stream Diversion
4) In-stream Passage
5) In-stream Habitat
6) Riparian Habitat
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8) Education/Coordination
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[2]Monitoring Protocol e.g., type of monitoring protocol [note: the specific reference to detailed monitoring protocol is identified in the "tool box"]):

- TMDL
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[4]Scale of Monitoring and Evaluation:

1) Project
2) Subbasin
3) Province
4) Columbia Basin

[5]Tool Box Tool

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SECTION – 36 Upper Columbia Subbasin Tables and Figures

Tables and figures are embedded within the text in sections 29 through 35.