Entiat
Subbasin Summary

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DRAFT: This document has not yet been reviewed or approved by the Northwest Power Planning Council

Entiat Subbasin Summary

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Disclaimer

The Northwest Power Planning Council (NPPC) intended the production of this subbasin summary to be a collaborative effort. Therefore, any party with information relevant to existing natural resources and conditions with the Entiat River subbasin was provided an opportunity to participate in the production of this document. Consequently, the document was created using information collected from many sources. The parties participating in the development and submission of this summary do not imply that they agree with or otherwise support all or any of the information submitted by any other party. All parties reserve the right to respond to and rebut any information within this summary or any document appended to the same, as they may deem appropriate.

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Subbasin Description

General Description

Subbasin Location

The Entiat Subbasin (Water Resource Inventory Area #46) is located along the eastern slopes of the Cascade Mountains in Chelan County in north central Washington (Figure 1). The Entiat River Subbasin is bounded on the north by the Chelan Mountains and on the south by the Entiat Mountains. The river drains about 419 square miles and originates high in the Cascade Mountains, near Spectacle Buttes and Mt. Maude. It flows southeast to its confluence with the Columbia River near the town of Entiat, about 20 miles north of Wenatchee (Kirk et al. 1995).

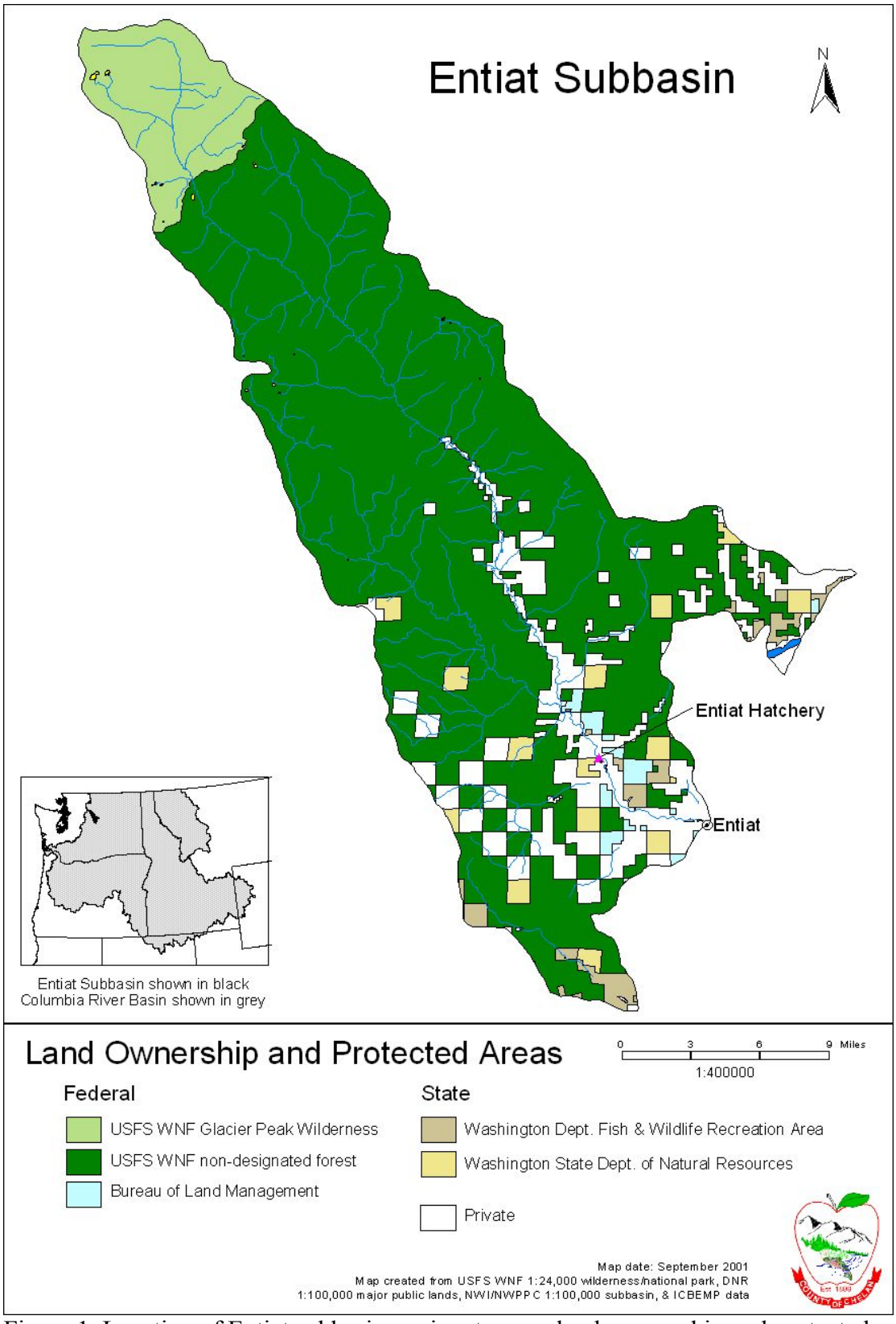

Figure 1. Location of Entiat subbasin, major streams, lands ownership and protected areas

Drainage Area

A rim of snow covered peaks supply the Entiat watershed's headwaters. The two largest perennial tributaries are the North Fork Entiat (20% of flow) and the Mad River (14% of flow), which join the Entiat River at river mile 33 and 10.5, respectively. Other perennial tributaries include Mud, Potato, Roaring, Stormy, Preston, Brennegan, McCrea, Burns, Fox, Tommy, Lake Silver, Pop, Three and Duncan creeks. The Entiat watershed also includes numerous intermittent tributaries (Andonaegui 1999).

Climate

Mean annual precipitation ranges from 90 inches in the moist alpine northwest portion of the watershed to 10 inches in the arid shrub steppe near the Columbia River. Most precipitation falls as snow in winter, with smaller amounts as heavy rain showers in July and August. During the summer, average daily temperatures in the mid elevations range between 60^{o}F and 70^{o}F with highs in the 90s and 100s. At higher elevations, temperatures decrease to the 50s. During the winter, average temperatures range from the teens to the 40s with occasional sub-zero temperatures (Andonaegui 1999; CCCD 1999).

Geology/Topography/Soil

Topography in the Entiat subbasin is stratified into three distinct types. The lower subbasin is comprised of rolling hills (indicative of an earlier geologic era when streams downcut slowly), a stream-incised V-shaped valley, and a broad floodplain made up of water-stratified silt, sand, and cobbles. In the mid-to-lower valleys, uplifting of the Cascade Mountains caused streams to become more erosive creating narrow incisive canyons. During the neo-glaciation period, a glacier, nearly 25-miles long, sculpted the upper Entiat River Valley into its characteristic glacial U-shape with a broad valley floor and terminal moraine covered in till (Andonaegui 1999; CCCD 1999).

Primary geologic components that comprise the Entiat River watershed include metamorphic gneiss and schist, intrusive granodiorite, quartz diorite, glacial and alluvial sediment, and volcanic ash (from Glacier Peak, 14 miles west of the Entiat River drainage)(CCCD 1999). Crystalline bedrock underlies the mantle of ash and valley sediments (Kirk et al. 1995). Elevation ranges from 9,249 feet at Mt. Fernow to about 713 feet at the river mouth (CCCD 1999).

Soils types in the Entiat are conducive to runoff and erosion. Grazing, road construction, timber harvest, and development have exacerbated the problem by compacting soil and reducing infiltration. It is thought that over-grazing by domestic animals in the Entiat at the turn of the century may have contributed to surface soil changes which have reduced soil moisture storage, increased soil moisture stress and promoted loss of native grass understories (CCCD 1999).

Vegetation

Vegetation ranges from semi-arid shrub-steppe in the lower end of the watershed through temperate forest, to alpine meadows in the upper reaches (Andonaegui 1999). Forest communities, including open, closed, and sub-alpine, comprise about 67 % of the subbasin, shrub-steppe makes up about 14%, open subalpine is just under 19% and less than 1% is non-vegetation (rock and water) (Table 1). Shrub-steppe communities, dominated by grasses and shrubs, are found in the lower Entiat below the tree margin or on drier sites in

forested areas. Common species include bitterbrush, sagebrush, bluebunch wheatgrass (*Agropyron spicatum*), junegrass, Sandberg's bluegrass (*Poa suandbergii*), and bottlebrush squirreltail. Scattered ponderosa pine and Douglas fir are also found in this region (CCCD 1999, USFS 1996).

Table 1. Entiat subbasin vegetation types by acres and percent

Vegetation Type	**Acres**	**Percent**
Shrub-steppe	36,777	13.7
Open Forest	48,925	18.3
Closed Forest	109,936	41.0
Sub-alpine Forest	20,966	7.8
Open Subalpine	49,941	18.7
Non-vegetation	1,190	0.5
Total	**267,735**	**100**

The open forest group is a transition zone between the less vegetated shrub-steppe below and the denser forest above. As such, many shrubs and grasses found in the shrub-steppe region comprise the understory in the open forest. The canopy cover ranges from 10-50% as in the closed forest and is dominated by ponderosa pine, Douglas fir, and grand fir (CCCD 1999, USFS 1996).

The closed forest group, with canopy cover of 10-50%, typifies plant communities between 1,000 and 4,000 feet. This plant group is made up of both dry stands with low productivity such as lodgepole pine and ponderosa pine, and highly productive moist stands of Douglas fir and grand fir (CCCD 1999, USFS 1996).

The subalpine/alpine region between 4,000 and 7,000 feet is interspersed with closed subalpine communities of more than 50% canopy cover, open forest (generally <50% canopy cover) and parkland, and meadows. Subalpine fir and lodgepole pine are the primary climax tree in the closed forest, while typical open forest trees are subalpine fir, Englemann spruce, whitebark pine, subalpine larch, and occasionally mountain hemlock. Low shrubs, forbs, and graminoids are also found in these higher regions (CCCD 1999, USFS 1996).

Exotic plant species are a problem in disturbed areas such as utility and transportation corridors, abandoned and semi-abandoned agricultural plots, gravel pits, grazing pastures, and construction sites. Widespread weeds include cheatgrass (*Bromus tectorum*), diffuse knapweed (*Centaurea diffusa*), and oxeye daisy (*Chrysanthemum leucanthimum*). Dalmation toadflax (*Linnaria dalmatica*) is found in the Tommy Creek drainage. Other species found in the Entiat subbasin are yellowstar thistle (*Centaurea solstitialis*) Canada thistle (*Cirsium arvense*), whitetop (*Cardaria draba*), common tansy (*Tanacetum vulgare*), scotch broom (*Cystius scoparius*) St. Johns wort (*Hypericum perforatum*), wooly mullen (*Verbascum thaspis*), and himalayan blackberry (*Rubus discolor*) (CCCD 1999, USFS 1996).

Hydrology

Mean monthly runoff data for the Entiat reflect the snowmelt domination of this system. Melt of the snowpack and corresponding peak flows in the lower elevation tributaries typically occur during the period between early May and mid-July. High elevation snowmelt and the gradual release of groundwater sustain much of the streamflow from late summer through winter. Occasional large frontal and convective storms in the spring, summer, and fall may increase flow or cause flooding (CCCD 1999, Kirk et al. 1995).

Annual runoff within the watershed can vary widely from one year to the next. For the period of 1957-1999, the 203-square-mile area above the U.S. Geological Survey gauge near Ardenvoir yielded an annual mean of 267,800 acre-feet, with an annual high of 451,140 acre-feet in 1972 and a low of 178,970 acre-feet in 1973. Likewise, water yield from the Entiat varies greatly between years. Mean flow for the Entiat at the mouth (419 sq. miles) for the period 1951-1958 was 367,379 acre-feet; but for 1970-1976 was estimated to be 528,275 acre-feet, a 44% increase. These figures emphasize the extremes in runoff that are experienced after large fire events, and/or as a result of natural fluctuations in precipitation and runoff. Approximately 75% of the mean annual runoff for the Entiat River watershed originate from the upper watershed, an area that represents somewhat less than 50% of the watershed area (CCCD 1999, Kirk et al. 1995).

Water Quality

In the Entiat watershed, all surface waters within the Wenatchee National Forest (WNF), including the Entiat River from its headwaters to the WNF boundary (river mile 20.5), are classified as Class AA (extraordinary) waters. The remaining portion of the Entiat River and all tributaries feeding into it, from the WNF boundary to the confluence with the Columbia River, are classified as class A (excellent) water (Andonaequi 1999).

Typically, late summer water temperatures are not a serious problem in the lower Entiat River. However, temperature and pH have exceeded state standards and the lower Entiat has been on Washington State's 303(d) list since 1992. Maximum temperatures are typically less than 15^{o} C., which is tolerable for rearing juveniles. The 1974-1986 stream temperature record for Entiat National Fish Hatchery (Entiat NFH) has a mean July-September water temperature of 13.6^{o} C. Temperature standards are periodically exceeded in the lower Mad River. At times, the pH readings at some sites reached 8.5, which exceeds the WD of Ecology standard, but the causes are not known and are assumed to be partly of natural conditions. Existing data indicate that summer water temperatures in the lower Entiat (downstream from Burns Creek) and lower Mad rivers often exceed 16^{o} C (CCPUD 1998). A study conducted by the USFS (1999) concludes that the natural geology and hydrology of the Mad River resulted in exceedences of State water quality standards without a factor of human influence. Winter anchor ice is a problem in the Entiat below Ardenvoir and in the Mad River (CCCD 1998).

Sediment levels, especially fine sediments, are affecting aquatic habitat and irrigation. These sediments are derived from both natural and human-caused (accelerated) sources (CCCD 1998). The natural range of variability of fine sediment loading in the Entiat River subbasin is unknown; but data from sediment core sampling indicates that it may be very broad. The level of fine sediment loading is above or at the upper limit of the natural range of variability in the lower Entiat, lower Mad, Stormy-Potato, Roaring-

Tamarach, lower mid-Entiat, Mud Creek, Brennegan-Preston, and Mills-Dinkleman fish productions units (Andonaegui 1999).

In some locations, failing or sub-standard septic systems and/or surface runoff from home sites may be carrying a variety of non-point source pollutants (e.g., pathogens, sediment, nutrients, etc.) that threaten water quality. Orchard management involves use of a number of agricultural chemicals (sprays and fertilizers) that pose a potential risk to water quality (CCPUD 1998).

Land Use and Ownership

The primary land uses within the Entiat watershed are agriculture, livestock production and grazing, timber harvest, residential housing, and recreation. Approximately 87% of the land area within the Entiat watershed is forested and most is in public ownership (Table 2, Figure 2), managed by the U.S. Forest Service (USFS) (232,222 acres; primarily Wenatchee National Forest), BLM (3,203 acres), and the state of Washington (7,668 acres). Both the Washington Department of Fish and Wildlife and the Washington Department of Natural Resources (WDNR) administer state lands (CCCD 1999). This condition lends itself well to implementation of restoration plans, but it substantially reduces the chances for creativity, since many landscape management decisions are set by the National Forest Plan and Record of Decision (CCPUD 1998). Most of the privately owned lands are in the valley bottom and within one mile of the main Entiat River, resulting from ease of transportation and suitability for agriculture. Private property comprises only 8.6% of subbasin lands (CCCD 1999); however, more than 75% of the riparian habitat for anadromous salmonids in the mainstem Entiat River are in this area. The majority of irrigated cropland is comprised of apple and pear orchards, located along the Entiat river downstream from the town of Ardenvoir. Most of the 9,000 acres (3,650 ha) (CCPUD 1998) of rangeland are located in the lower part of the basin near the town of Entiat, although much of the forested land is also used for grazing. Recreational uses, such as cabins and campgrounds, are mostly upstream of Ardenvoir (Kirk et al. 1995).

Table 2. Land Ownership in the Entiat subbasin by acreage and percentage

Owner	Acres	%
National Forest	232,222	86.8
Private	23,045	8.6
State of Washington	7,668	2.8
Bureau of Land Management	3,203	1.2
Other*	1,597	0.6
Total	**267,735**	**100**

*Includes federal fish hatchery, Chelan County PUD, and private and BLM lands in the farthest eastern portion of the watershed.

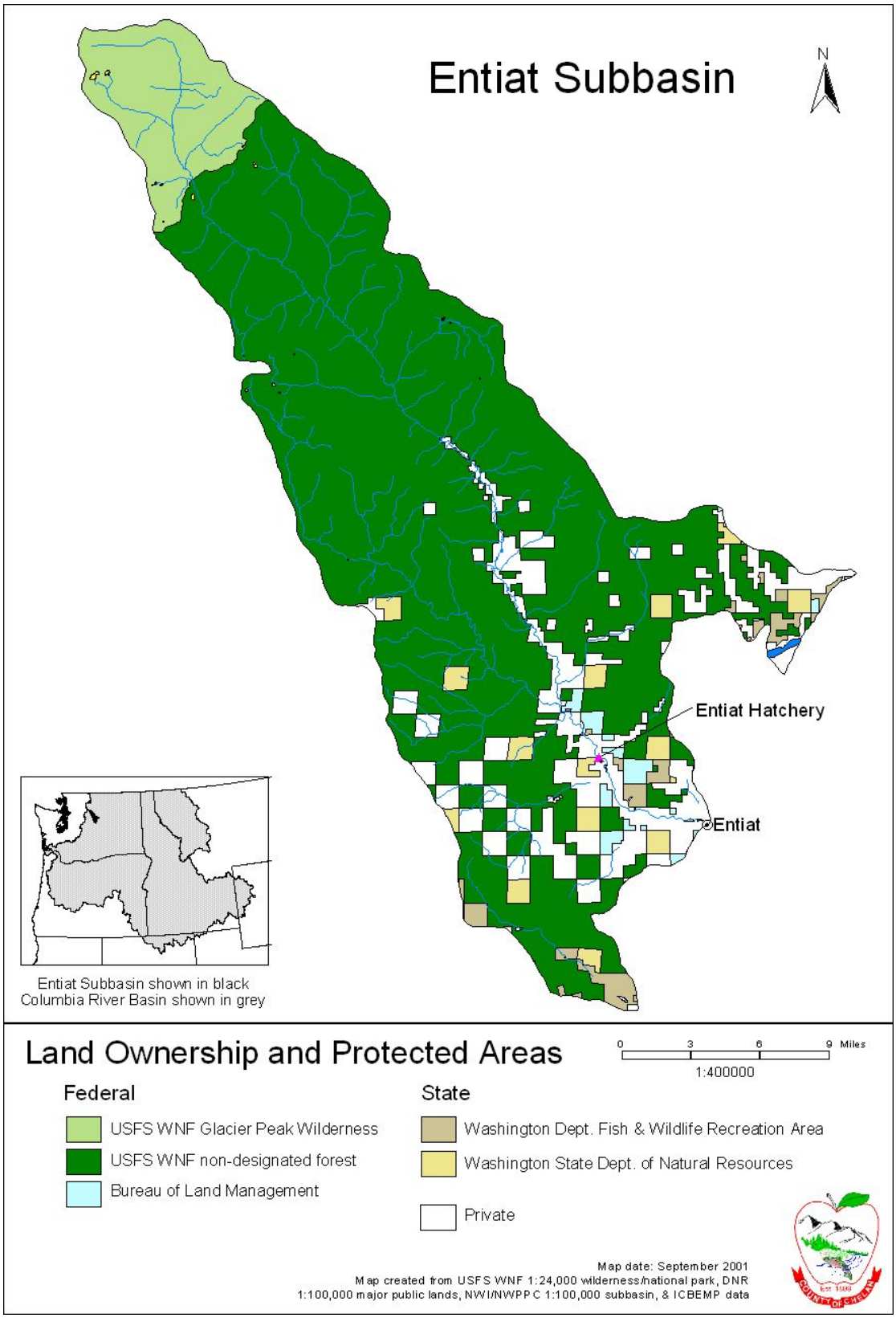

Figure 2. Land ownership and protected areas in the Entiat subbasin

Impoundments and Irrigation Projects

There are no reservoirs in the Entiat watershed although the lowest 0.5 miles of the Entiat River and floodplain is influenced by the backwatering effects of Lake Entiat, which serves as the pool for the Rocky Reach Dam Hydroelectric Facility on the Columbia River. No artificial ponds have been identified (Andonaegui 1999).

The Entiat River Subbasin Salmon and Steelhead Production Plan (Yakama Nation et al., 1990) identified water withdrawals, both agricultural and domestic, as an issue of concern relative to their potential to exacerbate normal low flows of late summer in the Entiat River. At that time, at issue was a need to set minimum instream flows at levels that would protect not only existing fish production, but also potential fish production, where appropriate. In 1997 the WDFW Yakima Screen Shop completed their most recent ground survey inventory of irrigation structures in the Entiat valley and identified two of the six ditch diversions and eight of the 45 pump diversions that were inadequately screened. Further, two private culverts on Stormy Creek have been identified as fish passage barriers that need to be replaced (Andonaegui 1999).

Protected Areas

Northern Spotted Owl Habitat

Critical habitats are those the Department of Interior has classified as important to the survival of a specific threatened or endangered species. Within the Entiat Watershed Analysis Area, the Indian Creek and Mad River drainages have been designated as critical habitat for the northern spotted owl (USFS 1996).

Protected Stream Reaches

On August 10, 1988, the NPPC designated certain river reaches in the Entiat subbasin as "protected areas," where the Council believes hydroelectric development would have unacceptable risks of loss to fish and wildlife species of concern, their productive capacity, or their habitat. Reaches or portions of reaches, and the fish and wildlife to be protected are listed in Table 3 (PSMFC 2001).

Table 3. List of stream reaches in the Entiat subbasin designated as protected areas (off-limits to dam construction) by the NPPC in 1988

Stream	Tributary to	Reach starts At	Reach Ends At	From RM[1]	To RM	Reach Length	Protected Category	Length Affected	Institutional Constraints
Cougar Cr	Mad R	Mouth	Headwaters	0	5.5	5.5	Unprotected	5.5	None
Entiat R	Columbia R	Mouth	Roaring Cr	0	6.1	6.1	A&RF[2]	6.1	None
Entiat R	Columbia R	Roaring Cr	Mad R	0	4.5	4.5	A&RF	4.5	None
Entiat R	Columbia R	Mad R	Mud Cr	0	1.1	1.1	A&RF	1.1	None
Entiat R	Columbia R	Mud Cr	Potato Cr	0	3.5	3.5	A&RF	3.5	None
Entiat R	Columbia R	Potato Cr	Stormy Cr	0	3.2	3.2	A&RF	3.2	None
Entiat R	Columbia R	Stormy Cr	Tommy Cr	0	4.7	4.7	Anadromous	4.7	None
Entiat R	Columbia R	Tommy Cr	Lake Cr	0	2.3	2.3	A&RF	2.3	None
Entiat R	Columbia R	Lake Cr	Entiat R, N Fk	0	5.1	5.1	A&RF	5.1	None
Entiat R	Columbia R	Entiat R, N Fk	Ice Cr	0	12.1	12.1	RF&W[3]	12.1	None
Entiat R	Columbia R	Ice Cr	Headwaters	0	5.3	5.3	Unprotected	5.3	None
Entiat R, N Fk	Entiat R	Mouth	Headwaters	0	10.2	10.2	Unprotected	10.2	None

Stream	Tributary to	Reach starts At	Reach Ends At	From RM[1]	To RM	Reach Length	Protected Category	Length Affected	Institutional Constraints
Ice Cr	Entiat R	Mouth	Headwaters	0	5.3	5.3	Unprotected	5.3	None
Indian Cr	Tillicum Cr	Mouth	Headwaters	0	5.3	5.3	Unprotected	5.3	None
Lake Cr	Entiat R	Mouth	Headwaters	0	8	8	Unprotected	8	None
Mad R	Entiat R	Mouth	Tillicum Cr	0	2	2	A&RF	2	None
Mad R	Entiat R	Tillicum Cr	Young Cr	0	6.9	6.9	Anadromous	6.9	None
Mad R	Entiat R	Cougar Cr	Headwaters	0	1.2	12.1	Anadromous	1.2	None
Mad R	Entiat R	Cougar Cr	Headwaters	1.2	12.1	12.1	Unprotected	10.9	None
Mad R	Entiat R	Young Cr	Cougar Cr	0	2.2	2.2	Unprotected	2.2	None
Mud Cr	Entiat R	Mouth	Headwaters	0	10.6	10.6	Unprotected	10.6	None
Potato Cr	Entiat R	Mouth	Headwaters	0	7.1	7.1	Unprotected	7.1	None
Roaring Cr	Entiat R	Mouth	Headwaters	0	7.8	7.8	Unprotected	7.8	None
Stormy Cr	Entiat R	Mouth	Headwaters	0	5.2	5.2	Unprotected	5.2	None
Tillicum Cr	Mad R	Mouth	Indian Cr	0	1.9	1.9	Anadromous	1.9	None
Tillicum Cr	Mad R	Indian Cr	Headwaters	0	1.1	3.5	Anadromous	1.1	None
Tillicum Cr	Mad R	Indian Cr	Headwaters	1.1	3.5	3.5	Unprotected	2.4	None
Tommy Cr	Entiat R	Mouth	Headwaters	0	5.6	5.6	Unprotected	5.6	None
Young Cr	Mad R	Mouth	Headwaters	0	4	4	Unprotected	4	None

Entiat Slopes Natural Areas Preserve

The WDNR established the 1,920 acre Entiat Slopes Natural Areas Preserve in 1989 to protect the only global population of Thompson's clover (*Trifolium thompsonii*), a plant listed as threatened in Washington State and as a species of concern by the Federal ESA. The preserve also protects the longsepal globemallow (*Iliamna longisepala*) and Snake River cryptantha (*Cryptantha spiculefera*), both listed as sensitive by the state (WSDNP NHR 2001).

Fish and Wildlife Resources

Fish and Wildlife Status

Anadromous Fish

The Entiat Subbasin currently supports anadromous runs of native chinook and steelhead, along with non-native sockeye (Mullan et al. 1992). Coho were once present in the watershed, but have since been extirpated; passage barriers on the Entiat River at the turn of the century probably contributed to their decline (Nehlsen et al. 1991).

Coho (Oncorhynchus kisutch)

Coho salmon have been extirpated from the mid-Columbia River region, including the Entiat subbasin, despite plantings of 46 million fry, fingerlings, and smolts from fish hatcheries between 1943 and 1975 (Andonaegui 1999)

Sockeye (*Oncorhynchus nerka*)

Sockeye salmon are not indigenous to the Entiat River. After they were propagated at Entiat NFH between 1941 and 1969, small number of sockeye salmon adults were observed on a discontinuous basis in the Entiat River during spawning ground surveys for chinook salmon. The most recent observation was one fish in 1995. These fish are either

strays from the Wenatchee and Okanogan stocks, or they may be artifacts of the Entiat NFH releases. Little is known about the life history of Entiat sockeye salmon; they are assumed to rear primarily in the impounded lower reach of the Entiat River and the Columbia River reservoir. Spawning occurs from mid-September to mid-October. It is assumed that juveniles move downstream from the Entiat River to the Columbia River reservoir immediately after they emerge from the gravel (March through May) (CCCD 1999)

Spring Chinook (*Oncorhynchus tshawytscha*)

There are two stocks of spring chinook in the Entiat subbasin, the natural spawning stock, which is ESA listed, and the hatchery stock (Entiat National Fish Hatchery) which is not (Carie 2001). The spring chinook spawns and rears primarily in the mainstem Entiat between the terminal moraine (rivermile 16) and Fox Creek confluence (river mile 28). They also spawn and rear in the lower Mad River (Figure 3). Adults return to the Entiat in late May-July and spawn between August and September. Juveniles emerge from late March through early May, move to the lower reaches of primary tributaries and the mainstem, and begin their emigration to the sea in late fall through the following spring (peaks in late April and May) (CCCD 1999). The average estimated natural escapement to the Entiat River (based upon dam count turnoff estimates from Rocky Reach to Wells dams) is 3,229 for the period 1960-1969, 2,965 for the period 1970-1979, 2,708 for the period 1980-1989, and 1,056 for the period 1990-1995 (Andonaegui 1999). Per Carie (2001), dam counts usually overestimate escapement due to fall-back, mortality, incorrect cut-off-date (which separates the spring and summer components,), and misidentification of species, and should be looked at with caution.

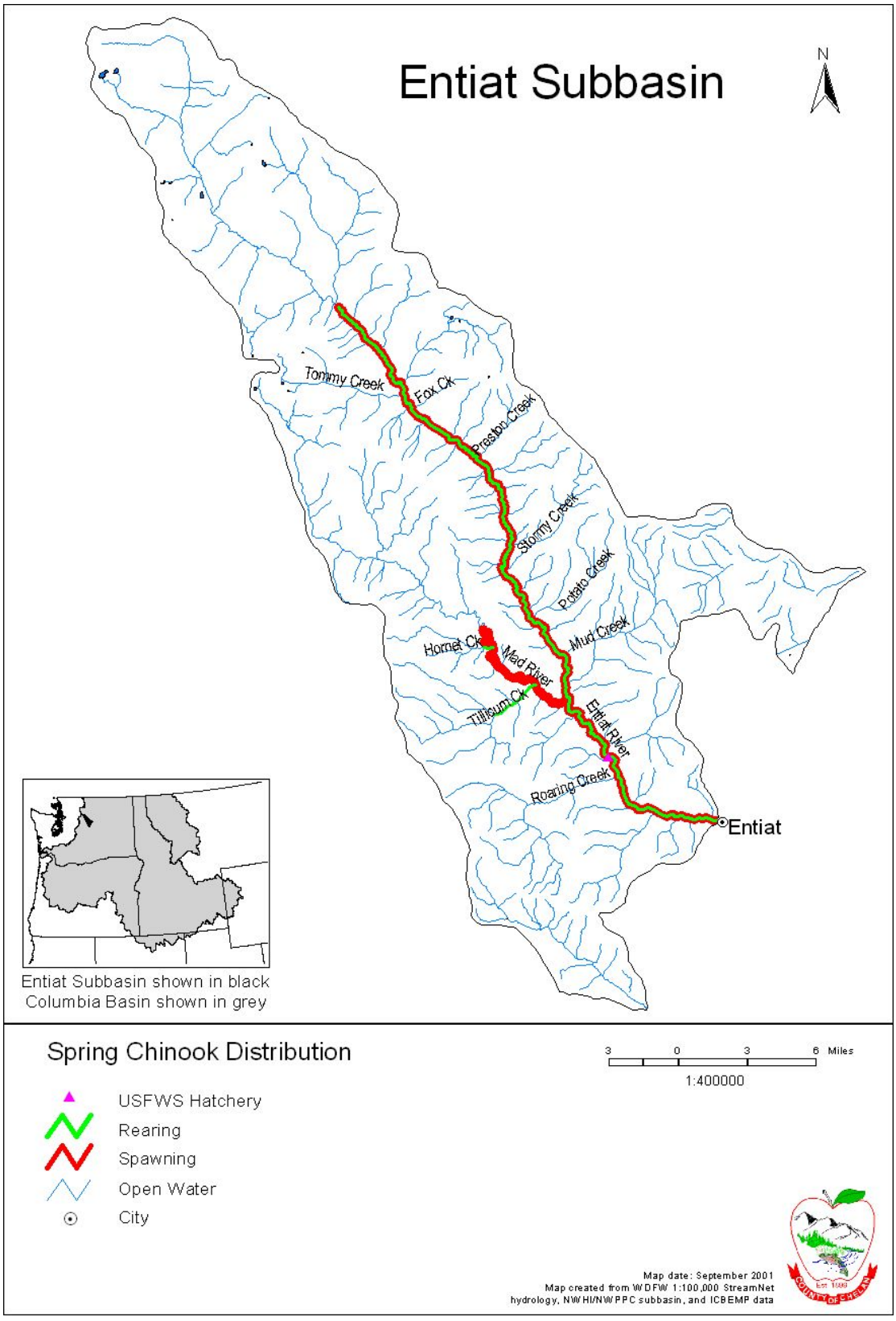

Figure 3. Spring Chinook distribution in the Entiat subbasin

Spring chinook is depressed throughout much of their current range and is in danger of extinction in many areas. The recurrent poor production has been brought about by a number of factors: low abundance, decreasing trends in abundance, widely dispersed spawning populations, fragmented and degraded habitats, high risks of genetic introgression from hatchery fish, low frequency of wild stocks, introduced fish, harvest, and smolt and adult migration mortality in the mainstem Columbia and Snake Rivers (MacDonald et al. 2000). The recent wild adult population in the Entiat averaged 175 from 1986-1995 (based on redd counts). The 33-year (1962-1995) average wild adult Entiat population averaged 437, with a high of 1,344 adults in 1964 (USFS 1996) and a low of 31 (Carie 2001) in 1995. The USFWS (2000) report an average of 386 adults returned to Entiat NFH between 1990 and 1999. Hatchery spawning escapement averaged about 500 fish/year over the same time period, but declined to 100 fish/year in 1994-95. The combined wild and hatchery spawning escapement has averaged 675 fish per year from 1980-1995 (USFS 1996). Wild spring chinook is included as an upper Columbia Environmentally Significant Unit and was declared endangered under the Endangered Species Act in March, 1999 (YN 2000).

Summer Chinook (Oncorhynchus tshawytscha)

In the Entiat River late-run chinook spawn only in the mainstem Entiat from the confluence with the Columbia River up to the Preston Creek confluence (approximately RM 23). They are the only salmonid to also spawn in the mainstem Columbia River (Andonaegui 1999).

Populations of summer chinook have declined substantially since 1957. Following reduction of harvest pressure in the mid-1940s, late-run chinook increased through 1957, then steadily declined despite little in-river harvest after 1963. Escapements averaged 37 for the period 1957-1966, 55 for the period 1967-1976, 9 for the period 1977-1986, and 11 for the period 1987-1991. It is suspected that late-run chinook were never a dominant life history strategy in the Entiat River system although they were depicted as the dominant upstream Columbia River run by early pioneers in the upper-Columbia (Andonaegui 1999). MacDonald et al. (2000) suggest that "summer chinook may not be endemic to the Entiat River, but may be an artifact of hatchery propagation conducted under the Grand Coulee Fish Maintenance Project"

Summer Steelhead (*Oncorhynchus mykiss*)

Summer steelhead is native to the Entiat subbasin. They spawn and rear in the low- and mid-Entiat River, as well as Brennegan, Mud, Potato, Preston, Roaring, and Stormy creeks from mid-March to the end of May (Figure 4) (CCCD 1999). The Mad River has been the primary producer of steelhead (MacDonald et al. 2000). Steelhead usually remain in the Entiat River or its tributaries for 1-2 years, and most spend about two years (females may stay longer) at sea. Hatchery smolts are planted into the mainstem Entiat between April 20-May 20 and 10% probably remain in the system for another year before migrating to the ocean (CCCD 1999).

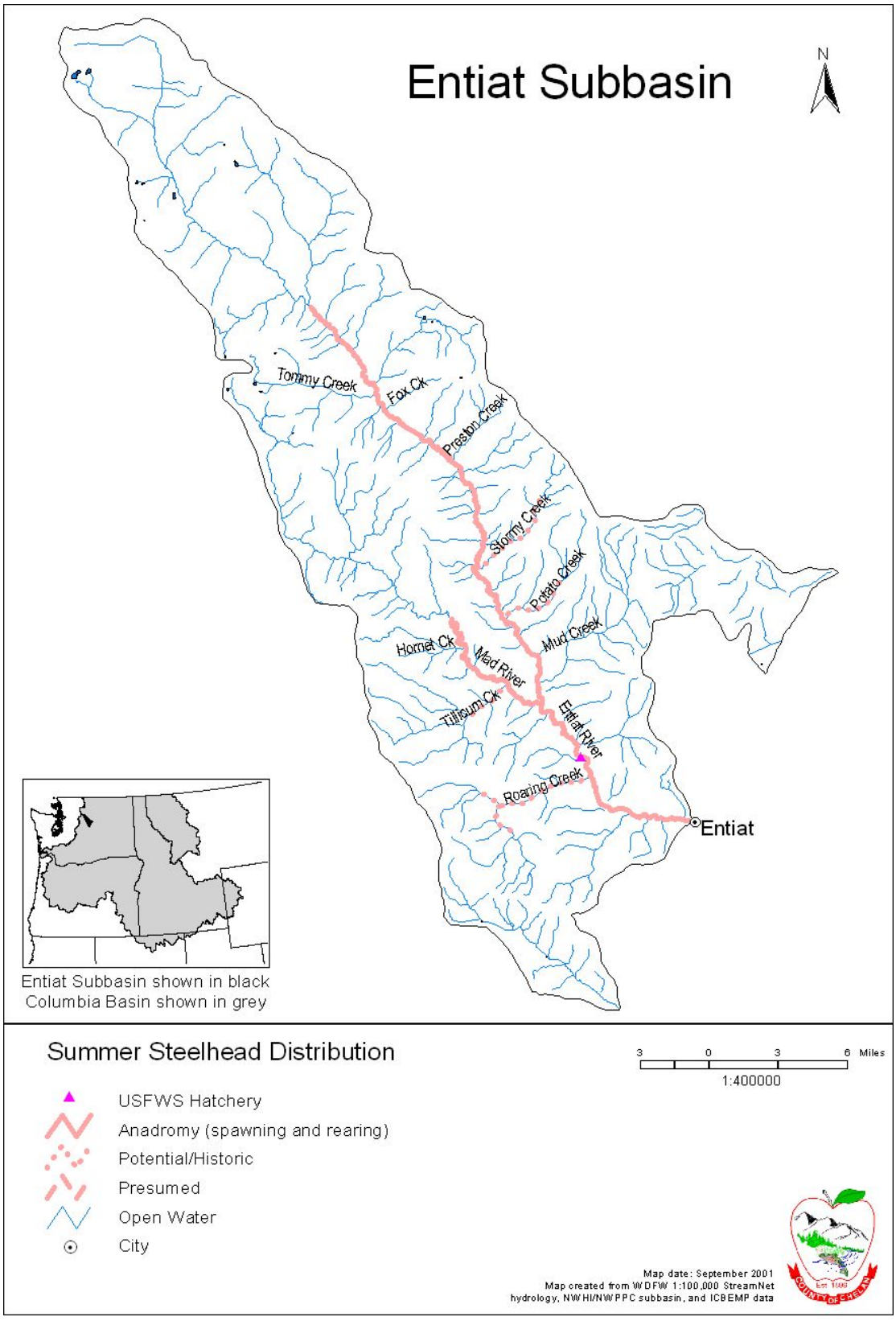

Figure 4. Summer Steelhead distribution in the Entiat subbasin

Historically, steelhead has experienced only moderate production in the Entiat watershed (Mullan et al. 1992). The construction of dams near the mouth of the Entiat River at the turn of the century blocked salmon from their spawning habitat and dramatically reduced their numbers by the 1930s (unidentified). Annual counts at the Rock Island Dam, beginning in 1933, show their numbers are rebounding. Peven (1992) and Mullan et al. (1992) attribute the increase to enhanced ocean survival and the supplementation of hatchery stock. Hatchery fish spawning in the Columbia River Basin have outnumbered wild steelhead for the last twenty years. Seventy-three percent of the steelhead entering the Columbia River in 1987 was of hatchery origin (Andonaegui 1999).

Summer steelhead is listed as depressed by SASSI (1992) and was listed as endangered under the ESA in August, 1997 (YN 2000). Past and proposed efforts may provide additional spawning habitat. Recently, improvements were made to a partial passage barrier near the mouth of the Mad River to open habitat to steelhead. In addition, further investigation may reveal that a section of the Roaring watershed, currently used by Redband trout, could be made accessible to steelhead (MacDonald et al. 2000).

Resident Fish

Dominant resident species include bull trout, westslope cutthroat trout, and rainbow trout. Other species found in the Entiat subbasin include mountain whitefish, eastern brook trout (salvelinus fontinalis), and redband trout (Oncorhynchus mykiss gibbsi*)* (Andonaegui 1999, CCCD 1999). The upper Entiat (above Entiat Falls) supports indigenous populations of rainbow and cutthroat trout. The WDFW supplemented these populations with annual stockings through 1996. The eastern brook trout was introduced upstream of Entiat falls, but is no longer stocked; a self-sustaining population still exists. Roaring Creek supports a "pure" population of redband trout and the North Fork Entiat and Lake and South Pyramid Creek have "good," but not pure populations (MacDonald et al. 2000). Large numbers of fish have also been stocked in other areas of the watershed, especially the high mountain lakes (Andonaegui 1999). A recreational fishery exists for rainbow and brook trout (CCCD 1999).

Bull Trout (Salvelinus confluentus)

Some bull trout have been observed in the mainstem below Entiat Falls; however, they spawn and rear in the middle and upper Mad and the upper Entiat rivers (Figure 5) (MacDonald et al. 2000). Annual bull trout spawning surveys have been conducted in a 7.5 mile long index reach on the mad river, which runs from the mouth of Young to the mouth of Jimmy creek, since 1989 (Archibald 2001). The Mad River supports the largest populations of bull trout, but their numbers may be dwindling. Only 16 redds were recorded in the Mad River index reach during 1995. The size and status of the upper-mid Entiat population is unknown (MacDonald et al. 2000). Bull trout from both areas were listed as threatened under the ESA in June 1998 (YN 2000).

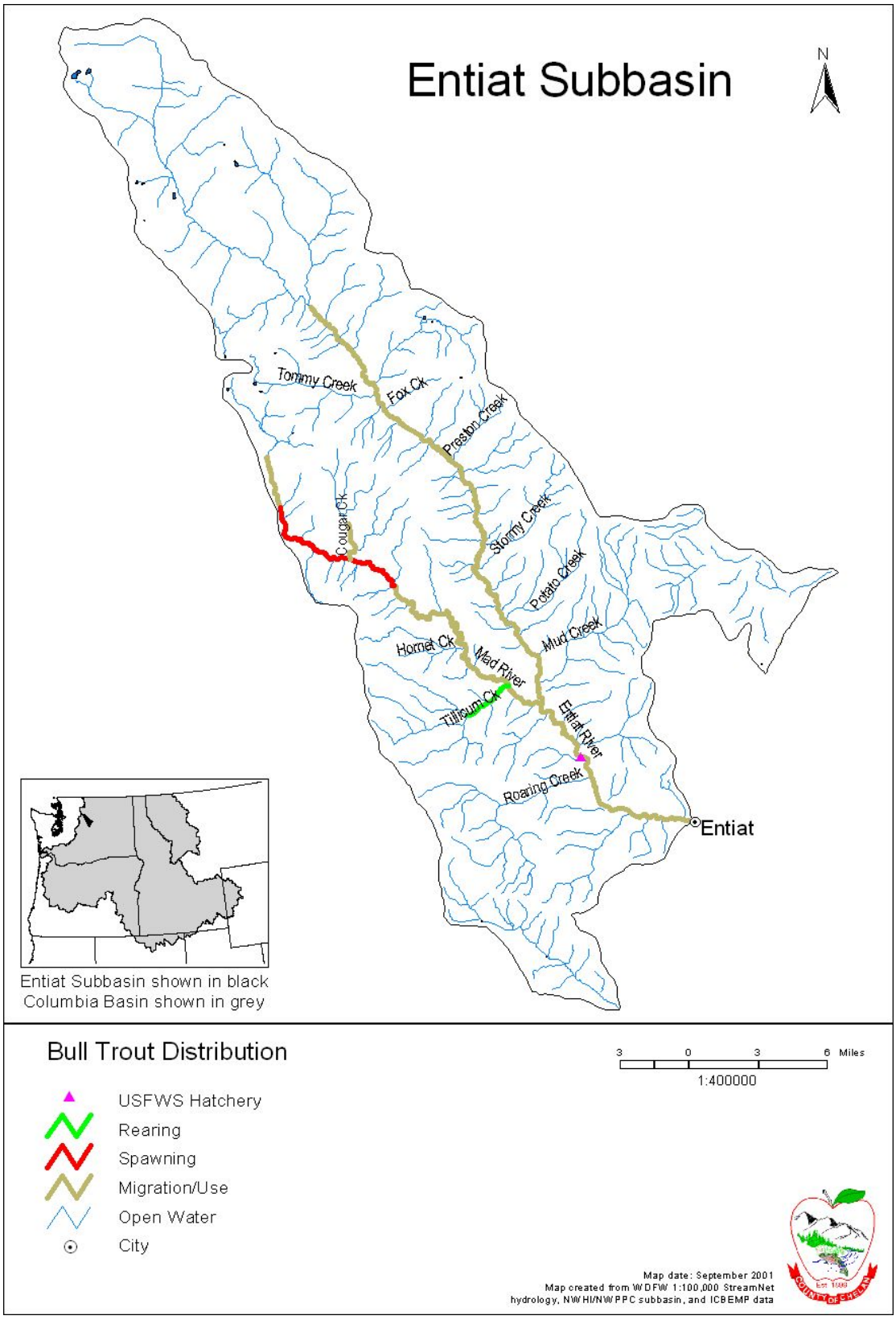

Figure 5. Bull trout distribution in the Entiat subbasin

Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi)*

Westslope cutthroat trout are native to the interior Columbia Basin. They are geographically distinct from other populations in the northwest, which may be important in terms of conservation measures. Concerns over the species status include genetic introgression (especially with rainbow trout, depressed and fragmented populations, and the loss of migratory life histories (MacDonald et al. 2000).

Four significant populations of cutthroat trout reside in the Entiat subbasin. Two distinct groups inhabit the lower Cougar Creek, a tributary to the Upper Mad River, and Tommy Creek, a tributary to the Entiat. The Tommy Creek group probably originated from two small stocked lakes in the headwaters of the subbasin. Cutthroat trout have also established hearty populations within the headwaters of the Mad (above rivermile 23) and North Fork Entiat rivers. These groups are classified as "good phenotypic representatives" (not completely pure) of the native cutthroat in the mid-Columbia basin (MacDonald et al. 2000).

Wildlife

Historical Background

Historically, the types and numbers of wildlife present in the Entiat subbasin have varied as much as the habitats on which they depend. Fluctuations in habitat conditions due to climate, wildfires, and other natural events have been a common occurrence in the subbasin. However, as European immigrants settled in the area, development, logging, roads, altered riparian zones, and fire suppression exacerbated natural disturbances. Impacts to the terrestrial environment have fragmented habitat for many species, while alterations to aquatic habitats have affected herons and other waterfowl, as well as amphibians, reptiles, and beavers (CCCD 1999).

Prior to European settlement, wildfires occurred frequently in the lower elevations, but were of low intensity and allowed for the maintenance of somewhat stable populations of elk (*Cervus elaphus*), deer (*sp. Odocoileus*), wolves (*Canis lupus*), grizzly and black bears (*Ursus arctos and americanus*), coyotes (*Canis latrans*), and mountain lions (*Puma concolor*) and beaver (*Castor Canadensis*). Fire-adapted open forests dominated by old growth ponderosa pine, supported populations of pileated and white woodpeckers (*Dryocupus pileatus* and *Picoides albolarvatus*), flammulated owls (*Otus flammeolus*), and pygmy nuthatches (*Sitta Pygmaea*). Lynx (*Lynx canadensis*), bobcats (*Lynx rufus*), marten (*Martes americana*), wolverine (*Gulo gulo*), and fisher (*Martes pennanti*) could be found in the dense forests of the upper Entiat (CCCD 1999).

As settlers moved into the area in the 1800s, game birds and mammals were trapped and shot to supply settlers and the army with meat and fur. Heavy grazing by domestic animals pushed out elk and bighorn sheep (*Ovis canadensis*) competing for similar forage staples. By 1900 populations of native species had been greatly reduced and conservation efforts were put in place. Elk and bighorn sheep were reintroduced (CCCD 1999).

Fire prevention and control policies of the early 1900s led to denser understory in the lower Entiat and to a greater number and variety of trees in mid- to low- elevation sites. Many of the new varieties were less fire tolerant than the ponderosa pine; this, coupled

with an increase in available fuels, caused wildfires to burn more intensely and over larger areas (1950s forward) (CCCD 1999).

Although there are hundreds of wildlife species (thousands when invertebrates are included) that use the wildlife habitats within the Entiat Basin for at least part of the year, there are 49 species in the priority listing for Chelan County which includes the Entiat Basin. Some of the more common species known to occur either currently or in the past, and their state of Washington status (game, endangered etc.) are shown in Table 4. Common wildlife species (CCCD 1999).

Table 4. Common wildlife species

SPECIES	STATE STATUS	COMMENTS
MAMMALS Big game ungulates		
Bighorn sheep *Ovis canadensis*	Game	Animals from a small introduced population in Swakane Canyon may use a portion of the basin. The biggest threat results from disease transmitted from domestic sheep.
Mountain goat *Oreamnos americanus*	Game	A small population uses the higher country in the watershed. Changes in the amount of foraging areas due to fire exclusion may be a threat.
Elk *Cervus elaphus*	Game	A small population uses the basin. The state Department of Fish and Wildlife does not manage for elk, not do they encourage their presence north of state highway 2, which includes the Entiat watershed.
Mule deer *Odocoileus hemionus hemionus*	Game	Mule deer are the most important big game animal in the basin. Although populations are currently depressed after the '94 wildfires. It will take 10-15 years for them to recover to post fire levels.
MAMMALS Carnivores		
Fisher *Martes pennanti*	Candidate	Occurred in the past, but there have been no recent confirmed sightings within the Entiat watershed.
Gray wolf *Canis lupus*	Endangered	There have been a few unconfirmed sightings in the past several years.

SPECIES	STATE STATUS	COMMENTS
Grizzly bear *Ursus arctos*	Endangered	Habitat exists and occurrence is suspected but not confirmed within the watershed. They are an extremely wide-ranging animal with individuals requiring several square miles of habitat.
Canada Lynx *Lynx canadensis*	Threatened	Sightings have been documented in the Basin.
Marten *Martes americana*	Furbearer	Was the most extensively trapped furbearer in the basin in the late 1800s. Marten occur in the more dense forest habitats in the mid and upper portions of the watershed.
Marine birds		
Common loon *Gavia immer*	Candidate	Occurrence documented in the past, but there have not been any sightings in the past 30 years.
Black-crowned night *Nycticorax nycticorax and* Great blue *Ardea herodias* heron	Protected	Great blue herons are commonly observed in the lower watershed.
Waterfowl		
Cavity-nesting ducks, Harlequin *Histrionicus histrionicus*, mallard *Anas platyrhnchos*, etc.	Game	These waterfowl are found within parts of the watershed during breeding and migration periods.
Hawks, Falcons, Eagles		
Peregrine falcon *Falco peregrinus*	Endangered	Birds have been seen in the basin.
Bald eagle *Haliaeetus leucocephalus*	Threatened	Bald eagles are known to feed in the watershed.
Osprey *Pandion haliaetus*, Prairie falcon *Falco mexicanus*	Endangered	Observations of both have been made in the watershed. Ospreys are common residents.

SPECIES	STATE STATUS	COMMENTS
Golden eagle *Aquila chrysaetos*, Northern goshawk *Accipiter gentilis*, Swainson's hawk *Buteo swainsoni*	Candidate	All three species have been observed in the Entiat Basin. Golden eagle and goshawk are basin residents.
Upland Game Birds		
Ruffed *Bonasa umbellus* & Blue *Dendragapus obscurus* grouse, Chukar *Alectoris chukar*, Calif. Quail *Callipepla californica*	Game	Occur within the basin with blue rouse, chukar and quail common in places.
Owls and Woodpeckers		
Northern spotted owl *Strix occidentalis*	Threatened	Resident within the watershed.
Burrowing *Athene cunicularia* and Flammulated *Otus flammeolus* owls	Candidate	Both species nest and forage in the basin.
Black-backed woodpecker *Picoides arcticus*	Protected	Nest and forage within the watershed
Pileated *Dryocopus pileatus* and White-headed woodpeckers *Picoides albolarvatus*	Candidate	Both species nest and forage in the basin.

Other vertebrate terrestrial species that may occur in the Entiat subbasin based on habitat types (CCCD 1999, WDFW 2001):

Endangered
Gray wolf *Canis lupus*

Threatened
Bald eagle *Haliaeetus leucocephalus*
Northern spotted owl *Strix occidentalis caurina*
Grizzly bear *Ursus arctos*

Designated
Critical habitat for northern spotted owl

Proposed
Canada lynx *Lynx canadensis*

Species of concern that may be proposed and listed in the future:

Invertebrates
California floater *Anodonta californiensis*
Columbia pebblesnail *Fluminicola columbianus*
Giant Columbia River limpet *Fisherola nuttalli*

Amphibians
Cascades frog *Rana cascadae*
Tailed frog *Ascaphus trui*
Columbia Spotted frog *Rana pretiosa*
Northern leopard frog *Rana pipens*
Western toad *Bufo boreas*

Reptiles
Northern sagebrush lizard *Sceloporus graciosus*
Sharptail snake *contia tenuis*
Striped whipsnake *Masticophis taeniatus*

Birds
American white pelican *Pelecanus erythrorhynchos*
Black tern *Chlidonias niger*
Burrowing owl *Speotyto cunicularia*
Canada geese *Branta canadensis*
Cormorants *Phalacrocoracidae*
Ferruginous hawk *Buteo regalis*
Grebs *Podicipedidae*
Harlequin duck *Histrionicus histrionicus*
Lewis' woodpecker *Melanerpes lewis*
Loggerhead shrike *Lanius ludovicianus*
Merlin *Falco columbarius*
Northern goshawk *Accipter gentilis*
Olive-sided flycatcher *Contopus boreali*
Ring-necked pheasant *Phasianus colchicus*
Sage grouse *Centrocercus urophasianus*
Sage sparrow *Amphispiza belli*
Sage thrasher *Oreoscoptes montanus*
Sandhill crane *Grus canadensis*
Sharp-tailed grouse *Typanuchus phasianellus*
Terns *Laridae*
Trumpeter swan *Cygnus buccinator*
Tundara swan *Cygnus columbianus*
Vaux's swift *Chaetura vauxi*
Wild turkey *Melagris gallopavo*
Willow flycatcher *Empidonax traillii*
Yellow-billed cuckoo *Coccyzus americanus*

Mammals
Big brown bat *Eptesicus fuscus*
Bighorn sheep *Ovis canadensis*
Canada lynx L*ynx canadensis*
Fisher *Martes pennanti*
Fringed myotis *Myotis thysanodes*
Long-eared myotis *Myotis evotis*
Long-legged myotis *Myotis volans*
Merriam's shrew *Sorex merriami*
Mink *Mustela vison*
Moose *Alces alces*
Northwest white-tailed deer *Odocoileus virginianus ochrourus*
Pallid bat *Antrozous pallidus*
Pygmy rabbit *Brachylagus idahoensis*
T. big-eared bat *Plecotus townsendii*
Washington ground squirrel *Spermophilus washingtoni*
Western gray squirrel *Scirurus griseus*
Western small-footed myotis *Myotis cilolabrum*
White-tailed jack rabbit *Lepus townsendii*
Wolverine *Gulo gulo*
Yuma myotis *Myotis yummanensis*

The USFS Watershed Assessment (1996) provides detailed information on the status of a number of wildlife species in the Entiat subbasin. Those summarized below are either endangered, threatened, or at risk, or are significant game and indicator species.

Mule Deer (*Odocoileus hemionus*)

Mule deer are the most important big game animal in the Entiat subbasin. This area contains the largest herd of wintering mule deer on the Forest. Most of the forest is used as summer range by deer. Winter range is in ponderosa pine, Douglas-fir, and shrub/steppe habitat series. In spring and fall, deer feed on high quality shrubs and forbs. In summer, their diet consists mainly of forage shrubs such as maple, serviceberry, chokecherry, red-osier dogwood, etc. In winter, they eat eriogoneum, bitterbrush, ceanothus, and other plants.

Mule deer populations decreased initially after the 1994 Tyee fire, but their numbers are expected to return to prior levels in about 10 years. Over the next 10-30 years, populations will likely decrease as limited water sources, human activities and ecosystem management (winter recreation, timber harvest, livestock grazing, and fire suppression) are implemented and habitat reduced.

Grizzly Bear (*Ursus arctos*)

There have been unconfirmed sightings of the grizzly bear in the Entiat subbasin. Denning occurs at the higher elevations in the alpine, subalpine fir and white bark pine series. The bear forages primarily on vegetation in wet/dry meadows, marshes, low gradient stream bottoms, riparian areas, berry-producing shrub fields, avalanche chutes, rivers, and streams. It also feeds on winter-killed deer, ground squirrels, mice, grubs, and ants. Currently, there are 235,000 suitable acres of habitat, but about 100,000 acres are not available for the grizzly use due to human activities.

Gray Wolf (*Canis lupus*)

The Gray Wolf population in the Entiat watershed has decreased significantly from historical figures. They are currently listed as endangered under the 1973 ESA, but numbers have grown slightly in this area over the last few years. Although there are no known den sites, they usually occur in remote country with sources of ungulates and water nearby. Prey includes deer, elk, mountain goats, bighorn sheep and small mammals. Presently, there are 235,000 acres of suitable habitat, but about 50,000 of the acres are not available for wolf use due to human activities: human-induced mortality, human disturbances and habitat alterations, reduced deer and elk populations, and grazing of domestic livestock.

Canada Lynx (*Lynx canadensis*)

Sightings of lynx have been documented in the Entiat region. Lynx are associated with habitat above 4000 feet elevation and use a mosaic of seral stand conditions. Their primary food source, snowshoe hare (*Lepus americanus*), is found in early successional lodgepole pine thickets, and lynx locate their dens in piles of large downed wood in late successional stands of larger conifers (silver fir, sub-alpine fir, white-bark pine series). (WS Assessm). Lynx populations are low throughout its range in Washington and are likely to drop even lower in future. It is listed as threatened by the state of Washington and a species of concern by the USFWS.

Beaver / Ruffed Grouse (*Castor canadensis / Bonasa umbellus*)

Both beaver and ruffed grouse occur in the Entiat watershed and the Tyee burn area, which provides 28,000 acres of suitable habitat. They are listed in the Wenatchee National Forest Land and Resource Management Plan as management indicator species for riparian areas. Beavers are found in rivers and streams in all successional stages of riparian habitat. They eat a variety of vegetation, but prefer quaking aspen and willows. Alders are commonly used in dam and lodge construction.

Ruffed grouse are found among deciduous trees and shrubs within the forests. They are most abundant in and near riparian habitats where they use heavy brush and thickets of young hardwood trees for cover, and feed on the buds and catkins of deciduous trees and shrubs, and on mast, berries, and insects. Their winter food is primarily deciduous buds, catkins and dwarf mistletoe. Disturbances (fire, timber production) within riparian and the more mesic upland forest stands maintain habitat for this species. A proper mix of conifer and hardwood edge with large woody debris on the ground is needed for breeding and winter habitat. The dense hardwood and shrub habitat favored by beaver and grouse is currently threatened by grazing, intensive fires, and roads built in or near riparian areas.

Peregrine Falcon / Bald Eagle (*Falco peregrinus / Haliaeetus leucocephalus*)

Peregrine falcons have been seen in the watershed and eagles are known to feed here during the winter. Peregrines nest on large rocky cliffs and feed primarily on birds in marsh, lake, river, and open upland feeding habitat. No nest sites have been found for either bird and the number of acres of potential nesting site is unknown. There are approximately 100,000 acres of feeding habitat.

Bald eagles are found in a wide variety of habitats including shrub-steppe, meadows, Douglas fir series, marshes, rivers, riparian, streams, and lakes. They need large trees for nesting (Douglas-fir, ponderosa pine, grandsir, western hemlock, and silver fir) and stands of large trees for roosting. They are known to fish the Entiat River and prefer to forage on fish and ducks, but will scavenge deer within the watershed during the winter.

The peregrine is listed as Endangered in Washington and the bald eagle as threatened in Washington and nationally. Populations of peregrine and bald eagle are anticipated to remain stable or increase forest wide in the future.

Northern Spotted Owl (*Strix occidentalis*)

Spotted owls have been known to exist in the Entiat watershed since 1986 when the first inventories were completed. Grand fir, western hemlock, silver fir and high site indexes of Douglas fir series comprise spotted owl habitat. Often, late seral stages provide habitat and sometimes mid-seral stages, as well. Generally, habitat has crown closure of 70% or greater, dominant trees larger than 12” dbh, mistletoe presence, large numbers of standing dead trees, large amounts of downed trees, and a multi-layered and multi-aged stand. Preferred prey is flying squirrels (*Glaucomys sabrinus*) and bushy-tailed woodrats (*Neotoma cinerea*).

The northern spotted owl is listed as threatened by both Washington state and the federal government. Logging and fires have destroyed or damaged spotted owl habitat. The trend is for habitat and populations to decrease over the next 40-60 years and possibly stabilize after that.

Habitat Areas and Quality

Geomorphic and hydrologic features of the Entiat subbasin have a significant impact on habitat availability and quality. The principal streams and adjacent lands can be broken down into four general habitat subcategories: (1) headwaters and alpine/subalpine communities (Transport Zone), (2) forested mountain slopes (Transitional Zone), (3) shrub/steppe and open forest (Depositional Zone), and (4) inland fish habitat (USFS 1996) (CCCD 1999).

Fish

Headwaters and Alpine/Subalpine Communities

This zone stretches from the headwaters of the Entiat subbasin to Entiat Falls near river mile 34. Fish and riparian habitat in this zone is stable (comparable to conditions in the 1930s) and in good to excellent condition. The unembedded cobble and gravel streams, large pools, side channels, boulders, course and fine sediment, and abundant riparian vegetation provide broad habitat diversity to rainbow, cutthroat, and eastern brook trout (*Oncorhynchus mykiss*, *Oncorhynchus clarki lewisi, Salvelinus fontinalis*). Hanging valleys and falls (Box Canyon – partial barrier, Entiat Falls – complete barrier), remnants of Pleistocene glaciation, prevent anadromous fish from migrating to this otherwise productive habitat.

As beavers have been trapped and removed from upper stream systems, flow regimes have been altered to some extent and water storage capacity has diminished. The extent to which hydraulic systems have been altered in unknown, however this area maintains a large groundwater storage capacity, which equates with high levels of vegetative growth, lowered sediment input to streams, and good to excellent levels of shade and large woody debris for aquatic species.

Fine sediment deposition in this zone is not a problem. Steep topography and unstable soils made up of volcanic ash, pumice, and loess make this a transport zone, with surface erosion, debris slides, sediment delivery, and surface runoff impacting downstream reaches. The effects of recreation, grazing, trails, and roads in this region are localized and minimal. Only 6.6 miles of road are located within 300 feet of a stream channel and road densities are below 1.0 mile per square mile.

Forested Mountain Slopes

This transitional zone extends from Entiat Falls to McCrea Creek near River Mile 25. Fish habitat conditions in this section are highly variable and have been unstable historically due to natural and human influences. Conditions range from excellent in the upper reaches (Entiat Falls to the Potato Creek), to poor in lower streams where management efforts such as sheep grazing and trailing, wildfire, fire exclusion, logging, road building, and recreation have led to soil compaction, destruction of riparian vegetation, increased runoff, and sedimentation. Thirty to sixty % of the pools in this zone have been lost in the mainstem Entiat, whereas pool habitat in the Mad River has recovered some during this time frame. Primarily bull trout (Salvelinus confluentus) and other resident fish utilize this varied habitat. Spring chinook (*O. tshawytscha*) and summer steelhead (*O. mykiss*) are limited to the lower reaches of this zone due to natural barriers.

Fine sediment loading is lowest in this area due to similar levels of sediment transport and deposition. Shade and large woody debris recruitment is fair to excellent and suppression of sediment discharge to streams is adequate where vegetation cover is good. Erosion and sediment deposition in channels are increased to some degree by the forty-three miles of road located within 300 feet of stream channels.

Shrub-Steppe and Open Forest

This zone comprises the area of McCrea Creek (near River Mile 25) to the Entiat's confluence with the Columbia River. It is a zone of heavy sediment deposition and stream downcutting. Fine sediments are deposited from steep hillslopes via high intensity summer storms, surface erosion, and debris flows to lower instream reaches and floodplains. A cycle of fill and scour occurs naturally along low gradient reaches within this land type.

This zone contains the principal spawning and rearing habitat for spring and summer chinook, sockeye (*O. nerka*), steelhead, bull trout, and other resident species, yet ranks fair to poor in habitat quality. Channel straightening, flood control dikes, and gravel mining conducted by the Corp to control floods have greatly confined and simplified river segments. Pools have been reduced by 90% since the 1930s, floodplain function has diminished, and water velocity is poorly distributed.

Agriculture, grazing, timber harvest, wildfires, residential development, and road construction have further degraded fish habitat. Surface water irrigation is the primary use of water in the subbasin and most new applications for water rights are in the lower reaches. Currently, six irrigation ditches and 45 pumps irrigate about 900 acres of apple and pear orchards and 200 acres of hay and pasture. Recent improvements in irrigation systems have reduced sediment buildup during high flows and flood events in the mainstem since the early 70s.

Historically, some portions of the Entiat watershed were extensively grazed, resulting in loss of ground cover, compact soils, erosion, and overland water and mud flows during high intensity storms. Grazing has been regulated by the USFS since the 1920s (CCPUD 1998), and currently, only 215-250 head of various livestock classes occupy the watershed for a portion of the year; between 145 and 185 are located in the main valley bottom. Much of the rangeland is fenced with 2,000 feet (three locations) of the lower 15.5-mile stretch of the main river accessible to livestock. Two of the three sites appear to have some unfavorable effects on streambank stability and water quality.

Forest management practices in the Entiat subbasin have had significant impacts in some of the minor tributaries (Burns, Preston, Brenegan, and McCrea creeks), and forest roads in the Potato, Mud, and Crum watersheds have had a significant negative impact on riparian canopy, soil, sediment loads, and pool habitat. Once economically important to the local community (1900 to 1980), the timber industry has fallen off dramatically in recent years. The last local sawmill closed in 1979 and the Wenatchee National Forest Land and Resource Management Plan as amended by the Northwest Forest Plan has reduced the number of acres that may be harvested.

Wildfires have also reduced the level of logging. Fires are a historical feature of the subbasin due to the dry hot climate, lack of rain in summer, and thunderstorms. Between 1970 and 1994, over 60% of the basin burned, vegetation was lost, and mud and debris

flows deposited sediment in stream channels. Harvest activity is not expected to return to previous levels anytime in the foreseeable future, rather, activities will focus on reforestation of burned areas and the underburning and thinning of timber stands to enhance forest health.

High-density development along or near the river on sensitive floodplains, coupled with current county regulations, threatens to further degrade streams. Vegetation removed to make way for homes has increased bank instability and reduced the function of these areas to regulate high flows. In addition, over one half of the 3,000 septic systems in the Entiat subbasin have been installed in the last 5 years. Although recent water quality testing indicates fecal coliform bacteria, nitrates, and phosphates meet criteria, development does have the potential to degrade existing water quality.

The lower Entiat is almost devoid of large woody debris, and riparian vegetation is non-existent in some areas. In some reaches, loss of vigorous shrubs in the riparian zone has reduced instream organic input and shade, and has contributed to unstable stream banks, erosion, and elevated water temperatures. Lack of vegetation and cover also contributes to freezing temperatures and anchor ice over much of this area in winter. These phenomena and others have significantly diminished suitable fish habitat. Sedimentation, gravel scour, and anchor ice heighten pre-emergence mortality, while fish in early rearing stages are left without adequate food or refuge from predators. Low instream flows and high water temperatures affect late rearing habitat in late summer and fall. Flow data collected at the gage near Ardenvoir since 1957 indicate that instream flows were lower than those recommended to maintain appropriate spawning and juvenile habitat for 221 days (86% of the time) for the period July 1 to March 15. Two gages near the mouth of the river show measured flows were below recommended levels for 170 days (50% of the time) (1911-1925 and 1951-1958), and 131 days (9-8-1996 to 2-9-1997), respectively.

Large variations in seasonal flows and resulting high temperatures in late summer and fall are primarily a result of natural processes operating in the subbasin and a result of channel modifications to the lower Entiat. To a lesser degree, water withdrawals for croplands also diminish flows. From 1957-1993 mean monthly flows at Ardenvoir ranged from 1,500 cfs in June to 80 in September (Kirk et al. 1995). The lower reach of the Entiat was on the State's 303(d) list in 1992 for temperature and pH excursions beyond water quality standards; inadequate instream flow below the forest boundary was added to the list in 1996. In 1998, both pH and temperature were deleted from the State 303(d) list.

Overall, fish habitat ranges from excellent in the upper watershed where steep topography prohibits encroachment by humans and natural processes remain relatively intact, to poor in the lower reaches where dry warm climates, upstream processes (sediment transport, erosion, runoff, and mud flows), and artificial manipulation of the environment have degraded water quality. Some current management practices have led to improvements in fish habitat via reductions in instream sediment, increased riparian vegetation, shade and woody debris, as well lowering the introduction of nutrients and contaminants into water bodies. The literature calls for additional investigations into factors within the subbasin which contribute to degraded fish habitat and timely implementation of management practices to alleviate these problems.

Inland Fish Habitat

Resident fish are known to occur with anadromous species, but are typically found in higher quality tributaries of less developed forests. The key to maintaining these habitats for resident fish, in particular rainbow, westslope cutthroat, and bull trout, is to minimize sedimentation and gravel scour, and provide adequate cover.

Wildlife

A variety of wildlife habitats are found within the Entiat subbasin (Figure 6) including shrub-steppe and open-forest, riparian, snags and logs, freshwater wetlands, aspen forest, caves, cliffs, aquatic, old growth/mature forests, prairies and steppe, talus slopes, and rural and urban natural open space. Thousands of vertebrate and invertebrate species use these habitats year-round, or seasonally, to feed, rest, and breed.

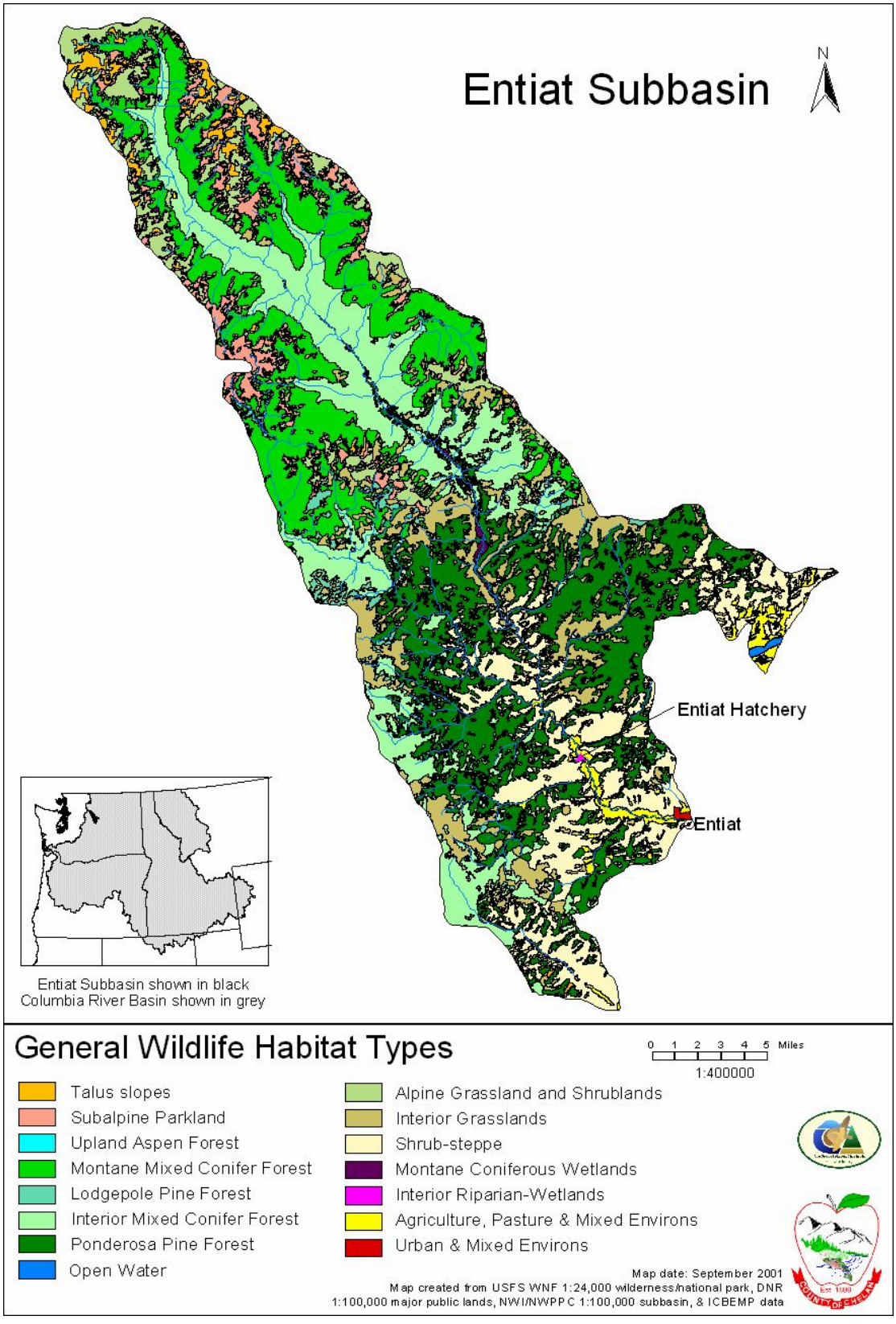

Figure 6. Wildlife habitat types found in the Entiat subbasin

Deer Winter Range

Shrub/steppe and open forest habitat are preferred by deer in winter and by the other species throughout the year. This area is characterized by shrubs, grasses, forbs, ponderosa pine, and Douglas fir communities. Deer winter range once covered about 100,000 to 200,000 acres in the lowlands and extended across the Columbia River (Prior to construction of the Rocky Reach Dam, water was lower and the channel was narrower in winter.) Small wetlands, meadows and riparian areas along streams, springs and adjacent forests provided deer and other wildlife with good thermal cover essential to cold, severe winters (USFS 1996).

Bighorn sheep and flammulated owl habitat overlap with deer winter range, which is composed of south-facing open slopes with nearby forests of Ponderosa pine and Douglas fir series old growth shrub/steppe habitat. Bighorn sheep live in steep, open, dry grass/shrub habitats generally below 4000 feet in elevation (shrub/steppe series). The flammulated owl is migratory (absent in winter) and prefers mature and old growth stands (stands older than 80 years) of ponderosa pine and Douglas fir for cavity nesting. It feeds primarily on large moths and other insects in areas with low shrub cover (USFS 1996).

Today, only 56,000 acres of winter range still exist. Reduced winter range size is attributed to a number of factors: 1) the Rocky Reach Dam /Rock Island Hydroelectric Facility commenced operation in 1961, flooding much of the low elevation winter habitat and preventing access to available habitat across the river; 2) the 1994 Tyee fire eliminated about 70 percent of the cover and forage provided in the winter range; 3) grazing and development (agricultural and residential) favors invasion by noxious weeds, diminishing the deer's native forage base of grasses and forbs; 4) roads constructed to accommodate timber harvest, development, and winter recreation (cross country skiing, hunting, and snowmobiling) have fragmented habitat and increased the number of deer killed by motorists (USFS 1996).

Riparian

Riparian areas are considered to be among the most productive habitats for wildlife density and diversity. Proximity to water, the edge effect between land and water, and hydrophytic and upland communities, all provide productive green succulent vegetation. Riparian zones provide hydraulic diversity, add structural complexity, provide refuge from predators and extreme environmental events, buffer the energy of runoff events and erosive forces, moderate temperatures, and provide a source of nutrients. Animals of all trophic levels thrive in these locations (Andonaegui 1999, USFS 1996).

Many species found in the riparian zone are the same as those inhabiting the adjacent uplands. The water and abundance of food in the riparian zone attracts these species. Acre for acre, riparian areas are more productive than the surrounding land. Some species, such as the water shrew, dipper, amphibians, some bats, many invertebrates and plants, are riparian obligates. An obligate species may not spend its whole life in a particular habitat, but it needs riparian habitat at some time in its life cycle for survival or reproduction. The following examples of obligate and non-obligate riparian wildlife may be found in this watershed (USFS 1996):

Obligate Riparian Species	Non-obligate Riparian Associates
Water Shrew	Vagrant Shrew
Silver-haired Bat	Little Brown Bat
Muskrat	Jumping Mouse
Beaver	Deer and Elk
Dipper	Ruffed Grouse
Harlequin Duck	Warblers and other songbirds
Frogs & Salamanders	Garter Snakes
Many invertebrates	Many other invertebrates

Riparian conditions within the Entiat can be separated into three zones: 1) transport zone (headwaters and alpine/subalpine communities), 2) forested mountain slopes (transitional zone), and 3) depositional zone (shrub steppe and open forest). Riparian vegetation in the transport zone consists of grand fir, Engelmann spruce, Douglas-fir, lodgepole pine, red cedar, cottonwood, grasses, and forbs. The amount of road located within 300 feet of a stream channel in this zone is 6.6 miles and road densities are below 1.0 per square mile. Riparian area impacts at developed campgrounds in this zone are localized and minimal, except for the concentrated use at Cottonwood Campground. Riparian zone function is good to excellent (CCCD 1999).

Riparian vegetation in the transitional zone consists of cottonwood, red cedar, grand fir, with dogwood and alder in lower elevations, and the addition of Engelmann spruce and western hemlock in higher elevation reaches. There are 43 miles of road located within 300 feet of stream channel in this zone. Most roads are native surface with minimal surface water control features. Riparian zone function is fair to excellent (CCCD 1999

Riparian vegetation in the depositional zone consists primarily of deciduous species with alder, willow, cottonwood, aspen, elderberry, redosier dogwood, river birch, maple, and conifers (i.e., ponderosa pine and Douglas-fir) being the dominant species. In some reaches, loss of vigorous shrubs in the riparian zone has reduced instream organic input, reduced shade, and contributed to unstable stream banks and associated erosion. There are a total of 205 miles of road located within 300 feet of a stream in this zone. Many roads are native surface with minimal surface water control features. Stream adjacent roads and associated management have reduced large woody debris recruitment. Riparian zone function is poor to good. (CCCD 1999)

Overall, the trend in riparian habitat conditions is toward fewer riparian areas due to dams, grazing, trapping of beaver, forest fires, and other anthropogenic activities. The Rocky Reach Dam Hydroelectric Facility flooded acres of productive bottomland. Although grazing has been reduced significantly from historical levels, it continues to be a problem in the Entiat watershed. Streambanks are destabilized, erosion and water temperatures increase, water quantity and quality is diminished, soils are compacted, vegetation is altered and destroyed, and channel hydrology, morphology, and instream structure are altered (USFS 1996).

Beaver colonies are some of the richest areas of biodiversity in northwest forests. Beaver dams raise the water table, kill back conifers and other plants not tolerant of

saturated soils, or they retard the growth of these species. Thus, the open canopy and abundant water near these ponds provide extended riparian and wetland plant communities which, in turn, support a rich and varied fauna. As beaver is removed, water regimes are altered and water storage decreases (USFS 1996).

While riparian habitats are temporarily destroyed by catastrophic events, such as the Tyee Fire that burned 32% of the Entiat watershed in 1994, these events can be beneficial by retarding succession to primary stages. This in turn creates habitat diversity within the riparian zone of the watershed. Beaver and ruffed grouse (management indicator species) are apt to benefit from early and mid-successional stages as the stands recover (USFS 1996).

Primary Cavity Excavator Habitat

Primary cavity excavator habitat (PCE) is important for many species of wildlife and is part of the functioning of an ecosystem. PCE habitat consists of standing dead trees, or live defective standing trees that provide cavities or potential cavities for vertebrates. Species such as the northern flicker, Lewis woodpecker, flammulated owl and bluebirds prefer dead trees in open grassy conditions. Stands of well-spaced, large old trees with their fire scars, large broken-out limbs, dead sections and snags provide cavities for roosts and nests, insects to feed on, and water (springs, ponds, streams, and wetlands) for flammulated owls and bats. Additionally, dead downed trees provide cover, food, and dens for snowshoe hares, chipmunks, voles, ground squirrels, shrews, and others (USFS 1996).

During the last 50 years, ponderosa pine trees have been logged for the manufacture of houses, apple boxes, firewood, and lumber. Some trees were removed to make way for the new young fast-growing trees and snags were felled due to safety hazards. Most of the large old-growth ponderosa pine trees and habitat were harvested, eliminating cavities used by bats and flammulated owls. Grazing reduced the ground vegetation that provided the moths and other insects. As a result, bat populations and flammulated owl populations have been greatly reduced in this watershed and throughout their range. This led to their listing as “sensitive” and may lead to a Federal listing of “threatened and endangered” (USFS 1996).

The 1970 fires in this drainage burned many thousands of acres and most big trees were salvaged. An examination of this fire area now shows almost no snags and the new trees are 2-6 in. diameter. In other words, these acres no longer contain primary cavity excavator habitat. Some of this fire area burned again in 1988 (Dinkleman fire) and 1994 (Tyee fire), leaving the area with no standing dead trees and no down logs to provide any potential habitat (USFS 1996).

It appears that PCE habitat may be below established levels over large areas of the Entiat Mad River watershed. This is a major problem in the lower elevations and in areas that have been burned by fires. Higher elevations and areas burnt by fires may have acceptable levels. Large areas will be devoid of standing and down PCE habitat for 50-100 years and maybe longer. This function will not completely return to these stands for 200-400 years (USFS 1996).

Wetlands

Wetlands are a transitional area between terrestrial and aquatic systems, which are covered by shallow water and provide important resting and breeding areas to fish and wildlife seasonally (WDFW 2001). The National Wetland Inventory (NWI) has mapped about 4,345 acres of wetland in the Entiat subbasin. It is believed that actual wetland acreage is higher than recorded due to deficiencies in the NWI mapping process (high altitude, aerial photography analysis) and the dynamic nature of wetland communities. A detailed wetland inventory, that includes ground-truthing, is needed to assess current wetland function, determine which areas provide critical resources to fish and wildlife, and to pinpoint areas for protection, restoration, and enhancement (CCCD 1999).

Aspen Forest

Pure or mixed stands of aspen greater than 2 acres (0.8 hectares) are home to a diverse array of fish and wildlife species. Unfortunately, these areas are highly vulnerable to habitat alteration and are of limited availability within the Entiat subbasin (WDFW 2001).

Caves / Cliffs / Talus slopes

Caves, cliffs and talus pilings provide significant breeding and seasonal habitat to unique and dependent species. Like other habitat types within the Entiat, these sites are limited in availability and are vulnerable to human disturbance, especially caves and talus slopes (WDFW 2001).

Rural and Urban Natural Open Space

Natural open spaces in the Entiat often support a dense and diverse array of fish and wildlife. Species typically inhabit areas within or near the open area and use it as a breeding and foraging range. Open space also provides a corridor for movement between habitats or may function as an isolated remnant of a natural habitat surrounded by agriculture and urban development. These sites are highly vulnerable to human encroachment and are becoming increasingly scarce (WDFW 2001).

Watershed Assessment

The Washington State Conservation Commission conducted a limiting habitat factors analysis of the Entiat subbasin, designated as WRIA 46 (Figure 7) pursuant to Engrossed Substitute House Bill 2496 (Revised Code of Washington (RCW) 75.46), the Salmon Recovery Act, a key piece of the 1998 Legislature's salmon recovery effort. The assessment, "Salmon and Steelhead Habitat Limiting Factors for the Entiat Watershed" was published July 6, 1999 (Version 3). Its purpose was to "[assess] the habitat-related factors limiting the ability of the habitat to fully sustain salmon populations in the Entiat watershed."

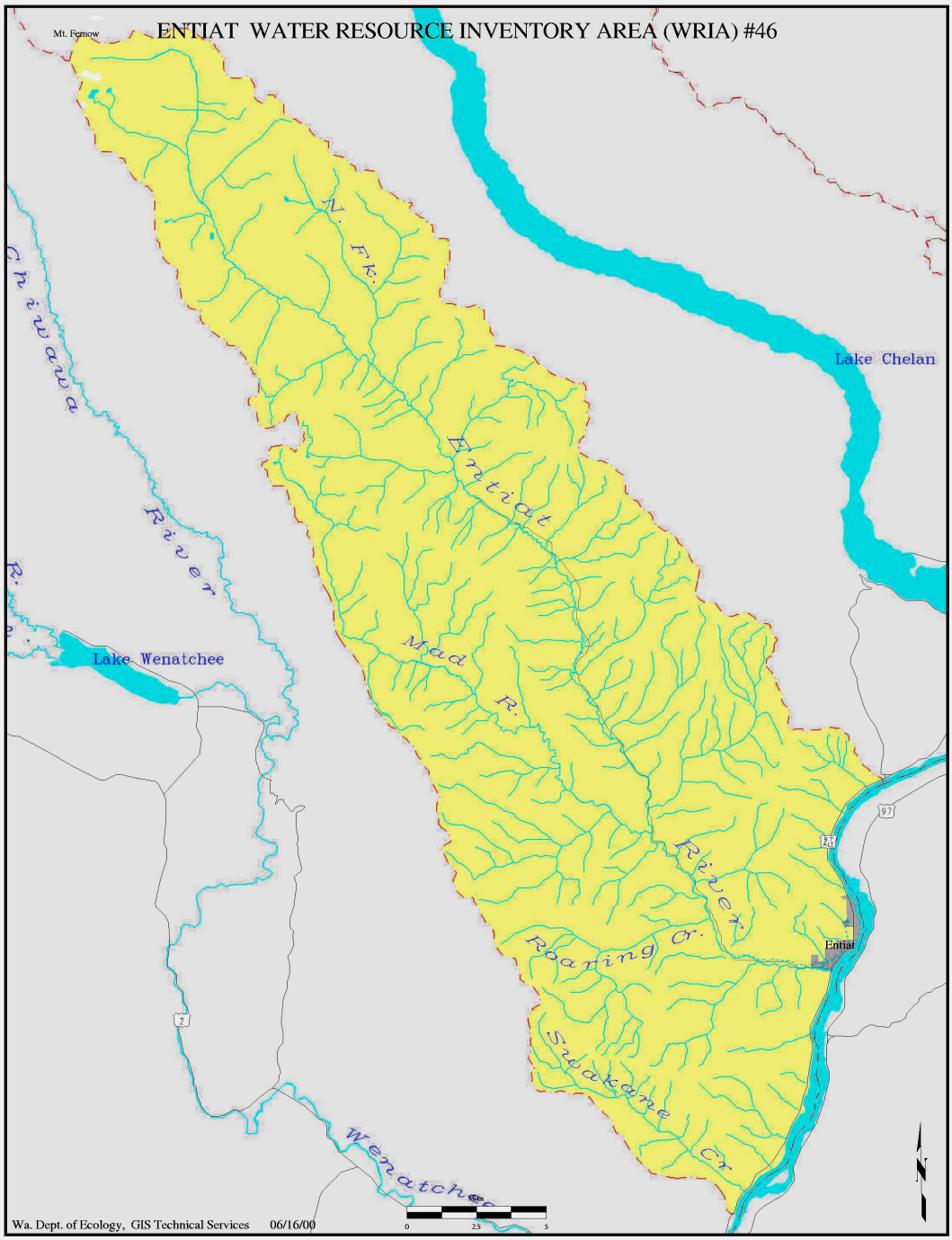

Figure 7. Entiat WRIA 46

The findings of the analysis, which was limited to consideration of anadromous fish, are to be used by a locally based habitat project selection committee to prioritize

appropriate projects for funding under Washington's salmon recovery program, as well as assist potential project sponsors in identifying projects. As part of the adaptive management process defined in 75.46 RCW, the "Salmon and Steelhead Habitat Limiting Factors" document will be revised as necessary when more information becomes available. Its findings serve as an important source for this subbasin summary.

Limiting Factors

Fish

The ability of the Entiat watershed to fully sustain salmon populations is most limited by a lack of overwintering juvenile habitat. Losses in floodplain and riparian zone connectivity and function have dramatically altered natural hydrological and geomorphic processes essential to juvenile survival. In 1948, following the worst flood recorded in Entiat Valley history, the Corps began a flood control project to channelize and dike the lower Entiat River, effectively eliminating habitat available to salmon and bull trout parr. Disconnecting channels from their floodplains and removing floodplain forests has: 1) blocked or eliminated overwintering habitats such as sloughs and side channels, 2) constricted the channel and increased flow velocity and scour during flood events, 3) reduced subsurface flows, 4) simplified streams (straightened channels and eliminated pools), and 5) diminished shade and large woody debris. Stream habitat protected from the effects of predators and winter flows, and pools with overhead are important habitat components for bull trout, steelhead and chinook (Andonaegui 1999).

Other factors have also contributed to the simplification of fish habitat. Historically, moderate to heavy sheep grazing in the uplands modified the understory grassy communities, and the removal of beaver diminished water storage capacity and altered flow regimes. Timber harvest, fire suppression, and the conversion of floodplains to crops, pasture, roads, and urban uses has contributed to losses in important salmonid rearing habitat through compacted soils, simplification and destruction of vegetative communities, accelerated sediment and water delivery to stream channels, and increases in the frequency, intensity, and duration of flood and mass wasting events. These conditions can hinder salmon productivity and/or lead to mortality of eggs, juveniles and adults (Andonaegui, 1999).

Loss of juvenile rearing habitat due to simplified channel and floodplain morphology is compounded by seasonal low flows. Low flows in late summer and fall are a normal offshoot of the natural hydrology and geography of the subbasin. Snowmelt peaks in spring and early summer leading to high flows, and tapers off to low flows in the late summer to early spring. In a pristine stream, high flows during the freshet create backwaters and flood shoreline vegetation to create low velocity rearing habitat however, human-induced conditions (water withdrawals, channel modification, alteration or removal of plants, agriculture, forest practices, urbanization, etc.) intensify the naturally low flows and reduce availability of high quality habitat. Low flows decrease spawning distribution, incubation survival, and dissolved oxygen and increase temperature, stranding, and predation (Andonaegui 1999). Kirk et al. (1995) noted that actual flow data for 1957-1993 are below recommended flows for much of any given year.

Improperly designed water diversions and dams, and unscreened and inadequately screened surface water diversions (pumps and ditches) also pose a direct threat to salmonids. The 1997 Yakima Screen Shop survey of irrigation structures in the Entiat Valley identified two out of six ditch diversions and eight of 45 pump diversions that were inadequately screened (CCCD 1999). In addition, two private culverts on Story Creek have been identified as fish passage barriers (USFS 1996).

Wildlife

Limiting factors vary for each species of wildlife; however, degradation and loss of habitat due to human development, logging, roads, altered riparian zones, introduced species, and fire suppression is a common theme. Development and land use activities have caused habitat fragmentation affecting most species including mammals, birds, invertebrates, amphibians, and reptiles. Alteration of riparian habitat has affected herons and other waterfowl, as well as amphibians, reptiles, and beaver (CCCD 1999). Habitat factors affecting a wide variety of wildlife, including those listed below are detailed in the USFS Watershed Assessment (1996).

Mule Deer (*Odocoileus hemionus*)

The most significant habitat factor limiting the ability of the Entiat watershed to support viable populations of mule deer is a decline in available winter range acreage (especially at low elevations). This is a common problem throughout the state of Washington. Reduced winter range size is attributed to a number of factors. The building of the Rocky Reach Dam in 1961 isolated winter ranges on both sides of the Columbia River, flooded small wetlands, meadows, and riparian areas that provided critical deer winter habitat, and created variable water levels. Much of the remaining habitat has been significantly modified by highway traffic on each side of the river, a railroad, orchards, residences, winter recreation, deer fences, agricultural use of the lowlands, and various other human uses.

Sources of thermal cover, winter forage, and water have also been diminished. Grazing and fire suppression has decreased the availability of forbs and grasses for deer food in winter, and noxious weeds are outcompeteing native plants in disturbed areas. The shrub component of the shrub-steppe community was greatly diminished by the Dinkelman (1988) and Tyee (1994) fires and isn't expected to return to pre-fire levels for 10 years. In addition, the Tyee fire eliminated most of the trees and tall shrubs that formerly provided thermal cover to deer and other wildlife. Many streams that once ran with water went underground due to past activities. It is believed that the fires have brought some streams back to the surface through recutting by water. This change in streams will likely increase the water in the riparian zone and eventually the species of plants and wildlife found in this location.

Grizzly Bear (*Ursus arctos*)

The grizzly bear is a wide-ranging animal that requires several square miles of habitat. It is listed as endangered in Washington State and threatened by the FWS due to loss of secluded habitat, human-induced mortality and disturbance, and habitat alterations (logging, mining, road construction, trails, and grazing). The average road density in this watershed is higher than recommended. The current population trend is unknown;

however, human use of suitable habitat is increasing, thereby decreasing habitat capacity for the grizzly bear.

Gray Wolf (*Canis lupus*)

Human-induced disturbance and mortality are the greatest threats to survival for the gray wolf. Since the early settlement of this watershed, wolves have been killed by humans, by shooting, poisoning, and trapping) to prevent damage to domestic livestock populations. Recently, trapping of wolves that attack permitted livestock on allotments was halted by the Wenatchee National Forest. Within two years, sightings of wolves increased substantially. Hunters may also shoot wolves accidentally or intentionally. It is hoped that education programs on wolves will reduce levels of mortality.

Roads and human activities have increased significantly in the last 90 years. Wolves have learned to avoid areas inhabited by humans because of the high mortality potential in those locations. Road and trail densities in this drainage are much higher that for this species in the Gray Wolf Recovery Plan.

Gray wolf populations are also hindered by a lack of mule deer, their primary prey. This is due to winter habitat degradation by the Tyee fire. It is assumed that the deer's population potential will be lower-than-normal during the period of fire recovery.

Canada Lynx (*Lynx canadensis*)

Knowledge of local populations and numbers of lynx is minimal. The Tyee fire of 1994 helped create a mosaic of high elevation forest, but road densities, the lack of quality denning habitat, and insufficient prey populations can limit lynx reproduction. Travel routes between habitat units are also essential to survival of this species.

Beaver / Ruffed Grouse

The key to sustaining beaver and ruffed grouse populations is to protect their riparian habitat from the effects of intense fires, grazing, and road development. Fire disturbance is a normal occurrence in the Entiat subbasin and, when the intensity of a fire remains within natural parameters, can be very beneficial to riparian-associated species by retarding succession to primary stages and promoting habitat diversity. Ruffed grouse broods and other species will profit from the establishment of low ground cover and an increase in insects, while both beaver and grouse will benefit from the natural succession of hardwood shrubs and trees and the resulting increased stream flows. Eliminating grazing and keeping roads away from wetland areas will also aid in recovery of native grasses and reduce the effects of erosion on riparian habitat.

Peregrine Falcon / Bald Eagle (Falco peregrinus / Haliaeetus leucocephalus)

Bald eagles were a common species in the Entiat watershed historically. However populations have dwindled due to loss of prey and habitat (anadromous and native fish populations, migratory ducks), eggshell thinning due to pesticide use, and persecution. Presently, the availability of sufficient prey and nest sites is likely the most limiting factors that influence the recovery of the species. Anadromous and native fish populations have declined due to habitat degradation, dams and hydropower development, harvest, and ocean conditions. Migratory duck populations are also low. Productivity is inhibited by logging of suitable nesting and roosting habitat, and recreational disturbances in nesting and feeding areas.

The availability of habitat and prey for the peregrine falcon is not entirely known. Most of the bird species fed on by peregrine falcons are available forest wide, but some prey species are declining and the overall result is less food. Additional concerns for the peregrine are falconry and disturbance to feeding areas.

Northern Spotted Owl (*Strix occidentalis*)

The 1994 Tyee fire damaged or destroyed a large segment of the spotted owl's habitat. There were 19,145 acres of suitable habitat and six pairs of spotted owls before the fire, and 9,500 acres of habitat, six pairs of owls, and two singles after the fire. While logging has eliminated habitat, it may also reduce the fire potential around nest sites.

Artificial Production

Entiat NFH is a mitigation hatchery established by the Grand Coulee Fish Maintenance Project (1937) to help compensate for anadromous fish losses above Grand Coulee Dam. It is located on the Entiat River, 10 km above its confluence with the Columbia River. The hatchery is funded by the BOR, operated by the USFWS, and is a sub-station of the Leavenworth NFH Complex. Production goals were set by the Columbia River Fisheries Management Plan Under the U.S. v Oregon decision of 1969.

Prior to the mid-1970s, several salmonid species were propagated at Entiat NFH including cutthroat, rainbow, and brook trout, kokanee, sockeye, summer steelhead, coho, and spring and summer chinook. Currently, only spring chinook (utilizing Carson ancestry stock) are produced. From 1990 to 1999, actual releases approximated the annual goal of 400,000 releases, with the exceptions of 1990 to 91, which were significantly above estimates, and 1997, which was about half the annual goal (Table 5) (USFWS 2000). For this same time period, an average of 386 adults have returned to the facility annually.

Table 5. Yearling spring chinook salmon released from, and adult returns to, ENFH, 1990-1999.

Year	#Released	# of Returning Adults
1990	585,800	583
1991	818,707	437
1992	343,150	520
1993	376,462	730
1994	378,729	80
1995	391,211	121
1996	335,593	175
1997	200,486	275
1998	350,784	216
1999	354,238	724

Summer run steelhead are reared at the Eastbank Hatchery and Chelan Hatchery for release into the Entiat River. The subbasin planner's objective is for 4,471 summer steelhead, of which 1,471 are natural and 3,000 are hatchery fish for harvest. There are currently no releases of summer chinook or coho into the Entiat River. In addition to the hatcheries, a

spawning channel has been constructed on the upper end of the Entiat River natural production area (CRITFC 1995, YN 2000).

Existing and Past Efforts

Many assessments that characterize the Entiat subbasin and its fish and wildlife have been completed. Inventories of the Entiat subbasin's aquatic resources date back as far as 1934 (U.S. Bureau of Fisheries 1934, 1935a, 1935b, 1936a, 1936b). Summer chinook aerial spawning surveys were conducted by the Chelan PUD on the lower 10.4 miles of the Entiat River from 1957-1991 (Carie 2001). A spring chinook spawning survey (biologists counted only once in an "Index" area) was initiated in 1962 by WDFW. In 1994, the spring chinook survey was taken over by the USFWS Mid-Columbia Fisheries Resources Office. More rigorous counting procedures were implemented (FWS cover the survey area a minimum of four times) and summer chinook surveys were added (Carie 2001).
Numerous other studies, which document the status and distribution of salmonid species and their habitats within the mid-Columbia basin and its tributaries, have also been produced (Brown 1992, Mullan et al. 1992, Caldwell and Beecher 1995, USDA NRCS Stream Team 1998).

Planning Efforts

Anadromous Fish Agreement and Habitat Conservation Plan

The Rock Island, Rocky Reach and Wells hydroelectric facilities, which are managed by the Chelan and Douglas County Public Utility Districts, filed an application with the NMFS for individual incidental take permits as part of their relicensing process. A comprehensive aquatic species and habitat assessment exhibit was produced to accompany the application (Rock Island Dam Hydroelectric Facility et al. 1998). This document provides a detailed analysis of aquatic species and habitat conditions in the Entiat subbasin, and provides recommended strategies for habitat protection and restoration.

Presently, protection for anadromous salmonids through the Rock Island and Rocky Reach reservoirs is guided by the proposed Habitat Conservation Plan. The HCP is in regulatory review, and is scheduled to be completed by spring 2002. The plan has an outcome-based approach and is designed to protect spring chinook salmon, fall/summer chinook salmon, sockeye salmon, steelhead, and coho salmon, after naturally spawning populations are reestablished (Peven 2001).

Chelan County Conservation District Watershed Planning

In 1998, the Chelan County Conservation District (CCCD) applied for grant funds for watershed planning under the Washington State Watershed Management Act, commonly referred to as "HB 2514" watershed planning, in late 1999. The existing CRMP effort noted above sought these funds through the Conservation District in order to broaden the scope of their effort and evaluate water quality, water quantity, instream flow, and fish and wildlife habitat more thoroughly. Anticipated products of the planning effort include documentation of a water budget for the sub-basin, identification of an in-stream flow recommendation for the Entiat River, and further assessment of other water quality and habitat issues, including development of TMDLS for compliance with the Federal Clean Water Act, if necessary. The planning effort is comprised of a "Planning Unit" that makes policy recommendations for the direction of the planning effort and "Technical

Subcommittees" that investigate specific areas of concern for the Planning Unit (Kaputa 2001).

Columbia River Inter-Tribal Fish Commission Anadromous Fish Restoration Plan

The Columbia River Inter-Tribal Fish Commission (CRITFC) produced an anadromous fish restoration plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit: Spirit of the Salmon*, for the Columbia River on behalf of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes (CRITFC 1995). The report includes a subbasin plan for the Entiat that details the status of indigenous fish, problems impacting fish resources, management objectives, ongoing activities and accomplishments, and specific strategies and actions.

Coordinated Resource Management Plan

The Entiat Watershed Steering Committee, in conjunction with the CCCD, NRCS, and USFS Entiat Ranger district, and numerous private stakeholders prepared a Coordinated Resource Management Plan for the Entiat (CCCD 1999). This document compiled data on water quality, fluvial geomorphology, fish populations, and recommendations for instream and riparian improvements, and offers resource recommendations that emphasize local customs, culture, and economic stability.

Cutthroat and Rainbow Trout Genetic Study

Cutthroat and rainbow trout are the focus of an ongoing genetic study in the Entiat subbasin (and the whole upper Columbia region). The purpose of this initiative is to look at the genetic integrity of stocks, the impacts of stocking, native species numbers, and how much hybridization has occurred (Archibald 2001).

Entiat Ranger District Vegetation and Road Condition Analysis

The Entiat Ranger District completed an analysis of vegetation and road conditions on forested and non-forested areas within the Swakane Canyon watershed and adjacent drainages that face the Columbia River. Proposed actions in this area include commercial timber sales, non-commercial thinning of conifer or hardwood vegetation, meadow restoration, existing road reconstruction, obliteration or closure, new road construction, and underburning (USFS 2001).

Entiat River Subbasin, Salmon, and Steelhead Production Plan

The Washington Department of Fisheries, Yakama Nation, Confederated Tribes of the Colville Indian Reservation, and Washington Department of Wildlife, with authority from the NWPPC, co-authored a salmon and steelhead production plan for the Entiat subbasin (WDFW et al. 1990). This document identifies salmonid habitat protection needs, constraints to and opportunities for production, and management recommendations for steelhead and spring, summer, and fall chinook.

Entiat Water Resource Inventory Area Planning Unit – Progress Report

"The purpose of [watershed planning] is to develop a more thorough and cooperative method of determining what the current water resource situation is in each water resource inventory area of the state and to provide local objectives for water resource management and development. It is necessary for the legislature to establish processes and policies that will result in providing state agencies with more specific guidance to manage the water resources of the state consistent with current law and direction provided by local entities and citizens through the process established in accordance with this chapter.

"The watershed Management Act, as outlined in RCW 90.82, provides grant funding for the establishment and implementation of watershed planning units and eventual watershed plans. The statute requires that each planning unit evaluate water quantity in the sub-basin and strategies for future water use. Optional elements include water quality, fish and wildlife habitat, and in-stream flows. The Entiat Watershed Planning Unit has elected to study all of the optional elements outlined under the Act (RCW 90.82)."

The Entiat Water Resource Inventory Area (WRIA) Planning Unit (EWPU) was established in September 1998, with the presentation of the grant award from Representative Gary Chandler to Phil Jones (EWPU Coordinator). However, the EWPU is composed primarily by members of the Entiat Landowner Steering Committee (LSC) and Technical Advisory Committee (TAC) formed under the UDSA-Natural Resource Conservation Service's (NRCS) Coordinated Resource Management (CRM) process. The Entiat CRM was initiated in 1993 by the CCCD and the Entiat Chamber of Commerce. The CRM and the EWPU are supported administratively and technically by the Entiat Ranger District, expanding on the FEMAT-based Entiat Watershed Assessments. The current structure of he EWPU is of a single, decision-making body. Four technical sub-committees work independent of the EWPU, though only in a technical capacity. An informal "administrative committee" comprising the CCCD, USFS, and Ecology meet regularly to assure timely progress, coordination of efforts, and to perform routine administrative functions. Following is a summary of products and progress to date (Monahan 2001a):

Products

- Phil Jones and Rick Edwards, August, 2001. Entiat Valley Watershed Study Coordinated Resource Management Plan– 2nd Draft Watershed Plan. 81 pp.
- Carmen Andonaegui. July 3, 1999. "Salmon and Steelhead Habitat Limiting Factors Report for the Entiat Watershed." 77 pp.
- Rick Edwards, Phil Archibald, W. Barry Southerland, and Karin Whitehall – Agriculture, Fish, and Wildlife Tour Package, 24 pp. The compendium contains information about the Entiat WRIA Planning Unit's vision and goals; planning unit status; planning unit membership; technical support group membership; historical timeline of events in the watershed; map of large fire occurrence; current hydrologic summary information; delineation of "headwaters, transfer, and depositional zones" of the watershed; illustrations of the longitudinal profiles of the Entiat and Mad Rivers; pool frequency comparisons (1930s vs. 1990s) for the Entiat and Mad rivers; max. weekly water temperature profiles of the Entiat and Mad rivers; min. and max. mean monthly water temperatures for the Entiat River (RM 26); fine sediment monitoring trends; Entiat and Mad river bull trout and chinook spawning trends; reach-by-reach breakdown of riparian vegetation condition (RM 0 to RM 20); and a reach-by-reach breakdown of pool and geomorphic stream classification (RM 0 o 20); and recommended alternative streambank restoration recommendations (RM 0 to 20). **Note: Some recent USFS monitoring data for the Entiat subbasin was not included in this summary. This important information has been included in Appendix A: *Agriculture, Fish, and Wildlife Tour, June 19, 2001 Draft Revision*. This document is a consolidation of much of the most current evaluation and monitoring results**

available for this area. The reader is encouraged to closely review this document.

- Instream Flow Workshop – Over 45 hours of videotape documenting the USGS-Biological Resources Division IF 251 "Designing and conducting Instream flow Analyses Using the Instream Flow Incremental Methodology – IFIM".
- Entiat WRIA Planning Unit – Habitat Subcommittee and Mobrand Biometrics, Inc. (MBI). July, 2001. Entiat EDT Watershed Analysis – Draft Progress Report". 155 pages.

Progress Setting Instream Flows

A chronology of events documenting the progress of the Entiat WRIA Planning Unit Workshop (3/2000) on the Instream Flow Assessment and Planning Task follows:

- June, 1999: Initiating government's consensus decision for all four elements (water quantity, water quality, habitat, and instream flow. Planning Unit consensus support.
- March, 2000: Entiat Instream Flow Technical Sub-Committee analyzes Entiat and Mad Rivers Fish Habitat Analysis Using the Instream Flow Incremental Methodology" (Caldwell and Beecher 1995). Recommended improvements were developed.
- April, 2000: EWPU consensus decision to use IFIM to address instream flow issues in the Entiat River watershed.
- Fall, 2000: CCCD submits SRF Board application for local, regional, and state technical and policy review.
- January, 2001: SRF Board approves Entiat IFIM grant application.
- April, 2001: IAC issues grant contract for Entiat IFIM grant.
- July, 2001: Consultant selected to assist with the Entiat IFIM

Schedule for Instream Flow setting

10/01- plan of work due, 10/01 through 9/02 –Implement Study, 7/02 through 9/02 - Alternative Analysis, 9/02 through 3/03 – Alternative Selection. 3/03 through 9/03 recommendations incorporated in Watershed Plan. After 9/03 the State will work with partners to implement approved elements.

Mule Deer Study

Over the past three years, mule deer have been radio collared and monitored throughout the Wenatchee and Entiat sub-basins. Approximately 40 different radio collars have been attached to deer while they are in their winter range in the lower Entiat River valley. The study objectives examine nutritional aspects of both summer and winter ranges, examine sources of mortality and track deer movement. Collared deer are monitored every week via a fixed winged airplane. This study is supported by the USFS, WDFW, the Confederated Tribes of the Colville Indian Reservation, Chelan County Public Utility District (CCPUD) and the Bonneville Power Administration. This study is expected to continue for several more years.

National Marine Fisheries Service – Studies and Reports

Studies and reports of the National Marine Fisheries Service (NMFS) (Foster 2001):

- Federal Caucus All-H Paper (2000). This document provides a framework for basin-wide salmon recovery and identifies strategies for harvest management, hatchery reform, habitat restoration, and hydropower system operations.
- Federal Columbia River Power System BiOp (2000). This is a biological opinion written by NMFS and the Fish and Wildlife Service regarding the operation of the federal hydropower system on the Columbia River, and fulfills consultation requirements with the US Army Corps of Engineers, the Bureau of Reclamation, and the Bonneville Power Administration under Section 7 of the ESA. This recent BiOp also concluded that off-site mitigation in tributaries is necessary to continue to operate the hydropower system.
- The NMFS conducted an assessment of aquatic species and habitat for the Wenatchee, Entiat, Methow, and Okanogan watersheds (1998). This assessment summarized information on aquatic species and their habitats in the four major tributaries to the mid-Columbia River. The emphasis was on anadromous salmonids.

Northwest Forest Plan

The Northwest Forest Plan was approved on April 14, 1994 and provides for coordinated land management for lands administered by the USFS and Bureau of Land Management (BLM) within the range of the northern spotted owl. Over 88% of the Entiat sub-basin is under the jurisdiction of the Forest Service and subject to the Northwest Forest Plan. This region-wide management direction will provide overall coordination across administrative units, provinces, and watersheds in Forest Service and BLM lands, for the areas and resources covered by the final Supplemental Environmental Impact Assessment (SEIS) issued in February 1994. The Plan is divided into two main sections: aquatic and terrestrial. The aquatic conservation strategy is aimed at restoring and maintaining the ecological health of watersheds. The strategy is designed to provide a scientific basis for protecting aquatic ecosystems and to enable planning for sustainable resource management. The goals of the terrestrial section of the plan are (1) to maintain late-successional and old growth species habitat and ecosystems on federal land and (2) to maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations (Kaputa 2001).

Sediment Sampling

From 1993 to present, fine sediment data has been collected annually in the Entiat's spawning grounds, using McNeil core samples. This allows collection of substrate embeddedness and composition data, and monitoring of spawning ground habitat conditions (Archibald 2001).

Temperature Monitoring

Temperature monitoring in the Entiat subbasin has been conducted with varying intensity and duration since 1993. Longitudinal profiles have been established every 2-3 miles from the mouth of the Mad River to its headwaters (Mad Lake). Profiles have also been established on the Entiat River from its mouth to river mile 38 (Cottonwood Campground). The period of data collection usually runs from June through October. Continuous data logging thermographs are also in place in the subbasin. Four years worth of data have been collected for the Mad river and three years for the Entiat River. Prior to that, temperatures

were taken at various point locations for monitoring. Monitoring of major tributary streams occurs throughout the subbasin (Roaring, Potato, Stormy, North Fork, Mud, and Lake creeks). Data collection and monitoring are ongoing, although longer monitoring windows have been implemented and better data collection devices are currently in use (Archibald 2001).

Upper Columbia Salmon Recovery Board

The Upper Columbia Salmon Recovery Board (UCSRB), a regional cooperative comprised of Chelan, Douglas, and Okanogan Counties; the Yakama Nation; and the Colville Tribes, formed in early 1999 to address regional fish and wildlife recovery issues. The Upper Columbia Regional Technical Team (RTT), established by the UCSRB, has produced a draft strategy designed to protect and restore salmonid habitat in the Upper Columbia basin using available technical information and the best professional judgment of regional fisheries biologist (UCSRB RTT 2001). It prioritizes areas for habitat protection and restoration throughout the Upper Columbia basin, and offers direction for the effective allocation of ESA-listed salmon recovery resources. The UCSRB RTT will release a companion report on assessment and effectiveness monitoring in early 2002.

USDA Cooperative River Basin Study

A USDA Cooperative River Basin Study (USDA et al. 1979) was initiated in 1975 and involved the Entiat Citizens' Committee; the USFS; the Economics, Statistics, and Cooperatives Service; and Soil Conservation Service. The effort was designed to collect and analyze data pertinent to water and related lands problems in response to multiple fire and flood events in the early 1970s. The study was completed in 1979 and outlined alternative means of reducing erosion and minimizing adverse effects of sediments.

U.S. Fish and Wildlife Service

Beginning in 1994, the U.S. Fish and Wildlife Service (USFWS) has conducted annual surveys of spawning spring chinook. Also, in 2001, the FWS collected tissue samples from the natural and hatchery spring chinook populations for DNA analysis. All samples came from post-spawn adults. This data will help to confirm or refute the assumption that the stocks are different or the same. The future management of the Entiat NFH is partially dependent upon the outcome of the analysis (Carie 2001).

U.S. Forest Service Watershed Assessment

The USFS, Wenatchee-Okanogan National Forest has completed a Watershed Assessment that covers all National Forest and Bureau of Land Management lands within the Mad and Entiat River key watersheds, and their adjacent Columbia River tributaries (USFS 1996). This report describes historic and existing terrestrial and aquatic species habitat, as well as soil, water, range, fire, scenic, and recreation conditions. It also presents key issues and provides resource management recommendations and preliminary desired future conditions.

Washington Salmon Recovery Act

Chelan County is designated a "lead entity" under the Washington Salmon Recovery Act (HB 2496) and assembles salmon habitat projects and project lists for submittal to the Washington Salmon Recovery Funding Board (SRFB). The lead entity process facilitates the development and attainment of salmon habitat project proposals within the County. The central component of the lead entity process is a citizen committee that establishes local

project priorities for the SRFB and develops a habitat work schedule for future salmon habitat protection and restoration efforts (Kaputa 2001).

Washington State Conservation Commission, Limiting Factors Analysis

The Washington State conservation Commission developed a limiting Factors Analysis for the Entiat subbasin (Andonaegui 1999). The report examined historic and current salmonid habitat conditions and distribution within the Entiat subbasin, and identified key factors limiting the ability of habitat to fully sustain salmonid populations (e.g., loss of access to spawning and rearing habitat, floodplain function, streambed sediment conditions, riparian zone condition, water quality and quantity, and introduced species).

Regulatory Activities

Chelan County Habitat Conservation Plan

Chelan County is currently developing a County wide programmatic Habitat Conservation Plan (HCP) for compliance with the Federal ESA. Potential parties to the HCP will include the County, cities, irrigation and special districts, private landowners, and others. Activities covered under the HCP will include road maintenance standards, stormwater management, vegetation management, planning and development, water supply infrastructure, parks and open space management, agricultural activities, public facilities and buildings, and planning and development. Species covered under the HCP will include salmon, steelhead, bull trout, and various terrestrial species (Kaputa 2001). The HCP is in regulatory review and is scheduled to be completed by spring, 2002 (Peven 2001).

Growth Management Habitat Protection Plan and Regulations

Chelan County adopted a comprehensive plan and development regulations in September 2000 that include significant regulatory protection for riparian areas, wetlands, frequently-flooded areas, geologically hazardous areas, aquifer recharge zones, and fish and wildlife habitat. The plan and regulations are compliant with Washington Growth Management Act requirements (Kaputa 2001).

Habitat Improvements and Protection

Conservation Easement Program

Chelan County is currently implementing a $1.5 million conservation easement program that will protect riparian areas along salmon-bearing streams of the Wenatchee and Entiat sub-basin. In addition to conservation easements, the program includes long-term agricultural leases of orchard property within the sub-basins that will be restored with in-kind assistance from the Chelan County Public Utility District #1 (Kaputa 2001).

Entiat Rock Weirs

This pilot project was designed to provide additional in-stream structure for salmonids (Kaputa 2001).

Entiat Slopes Natural Areas Preserve

In 1989, the WDNR established the 1,920 acre Entiat Slopes Natural Areas Preserve to protect the only global population of Thompson's Clover, as well as longsepal globemallow and Snake river cryptantha (Kaputa 2001, WDNR NHP 2001).

Jon Small Off-Channel Rearing Pond

The Jon Small Off-Channel Rearing Pond provides additional habitat for salmonids (Kaputa 2001).

Spotted Owl Surveys

Spotted owl surveys occur in the Entiat subbasin every year. Inspections are made of known nest and habitat areas, and new areas when needed, especially in proposed project areas (Archibald 2001).

Stillwaters Land Acquisition

The Chelan-Douglas Land Trust obtained $1.4 million from the Washington Salmon Recovery Funding Board in 2001 to purchase 300 acres and almost three miles of riparian areas of critical salmon habitat in the Entiat Valley. The property is located in the Stillwaters reach of the Entiat sub-basin, between RM 16 to 26 (Kaputa 2001).

Stormy Creek Culvert Replacement

Provides fish passage for all life stages of salmonids (Kaputa 2001).

Washington Department of Fish and Wildlife, Yakama Screen Shop – Fish Screens

Fish screening projects provide tangible and significant improvements to juvenile fish survival (compared to obsolete screen technology), with both immediate and long-term beneficial impacts. New fish screens comply with current state and federal biological protection criteria to reduce direct mortality and indirect mortality (caused by stress and injury) to both anadromous and resident salmonids, including ESA-listed spring chinook and steelhead (Endangered), and bull trout (Threatened) in Entiat River basin. In addition, screening projects complement and enhance other investments in upstream passage, habitat restoration, and hatchery supplementation of wild stocks by reducing injury and mortality of fish associated with legal gravity and pump diversions (Egbers 2001).

The NWPPC and BPA have made substantial investments in the Columbia Basin anadromous fish recovery effort. These investments are considered off-site mitigation for habitat losses in the Columbia River, and are predicated on the fact that substantial wild salmon production potential still exists because large expanses of accessible, high quality spawning and rearing habitat still exists in parts of the basin. Improved juvenile fish survival at Entiat River basin gravity water diversions is widely believed to be important in improving overall egg-to-smolt survival of critically depressed stocks of naturally-produced spring chinook, steelhead trout, and bull trout. Evaluation studies conducted in the Yakima Basin have shown that survival and guidance rates associated with fish movement through new fish screen facilities range from 95-100%. Following is a list of fish screening projects completed in the Entiat subbasin (Table 6) (Egbers 2001):

Table 6. Fish screening projects completed in the Entiat subbasin

Project Name Region/District	Type	Estimated Cost (000)	Estimated Construction Date
Horan Diversion (Mad R) Reg. 2 / Dist. 7	Fish Screen replacement	$20	Fall 1995 Completed
McKenzie Ditch (Entiat R) Reg. 2 / Dist. 7	Fish Screen replacement	$40	Fall 1997 Completed
Martin Sanders (Entiat R) Reg. 2 / Dist. 7	Fish Screen replacement	$7	Winter 1998 Completed
Hanan-Detwiler Ditch (Entiat R) Reg. 2 / Dist. 7	Fish Screen replacement	$80	Spring 1998 Completed

Present Subbasin Management

Existing Management

The Entiat subbasin drains approximately 268,000 acres, of which 224,000 (84%) is in public ownership, primarily Wenatchee National Forest, BLM lands, and lands administered by the WDFW and the WDNR. Of the remaining privately owned land, about 1,300 acres (75% of the riparian habitat for anadromous salmonids) are in lower valley orchards classified as prime agricultural land, making agricultural landowners important potential participants in the restoration and protection of subbasin fish, wildlife and water resources (USFS 1996).

Federal Government

Bureau of Land Management

The Bureau of Land Management (BLM) manages public lands for the multiple purposes of wildlife, recreation, timber harvest, livestock grazing, mineral extraction and other public uses (BLM 2001). In the Entiat subbasin, they manage 3,203 acres (1.2% of the subbasin) (CRMP 1999), most of which is on the north side of the Entiat River and consists of grasslands scattered with timber. Land is managed primarily for grazing and recreation (hunting and hiking). Two eight-acre parcels and one 80-acre parcel lie along the river. Burned timber was salvage logged from the 80-acre plot after the 1994 Tyee fire. This was followed by two fish habitat restoration projects on the same parcel in 2001. Logs with root wads were anchored in the stream with boulders to act as a log-jam and provide

fish with shade and protection. The BLM also participates in the Entiat Watershed Planning Unit (Kelly 2001).

Environmental Protection Agency

The Environmental Protection Agency (EPA) and Washington Department of Ecology (Ecology) are responsible for carrying out the Clean Water Act, including overseeing the development of and implementation of Total Maximum Daily Load (TMDL) plans.

National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) administers the Endangered Species Act (ESA) for anadromous fish. NMFS reviews and comments on activities that affect fishery resources and develop recovery plans for listed species in the Subbasin. Under the ESA's 4(d) rule, "take" of listed species is prohibited and permits are required for handling. Biological Opinions, recovery plans, and habitat conservation plans for federally listed fish and aquatic species help target and identify appropriate watershed protection and restoration measures (Foster 2001).

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS), a federal agency within the U.S. Department of Agriculture, works in cooperation with the CCCD to assist landowners in monitoring water resources, and implementing water resource, water quality, and habitat conservation projects (characterized as Best Management Practices), through development of on-farm conservation plans. A recent example is the installation of rock-vortex weirs in the mainstem Entiat River. The projects were developed through the Entiat Coordinated Resource Management Planning Process (CRMP) by NRCS technical staff, approved by the Landowner Steering Committee of the CRMP, and supported by the EWPU, with matching funds used to leverage Salmon Recovery Funding Board. The NRCS engineer provided design services, and the CCCD provided grant administration and managed the bid process (Monahan 2001).

The CCCD and NRCS will continue to work through the EWPU throughout the duration of the watershed planning process. The watershed plan is scheduled for completion in September of 2003. Implementation of recommendations is ongoing, but will begin in earnest with the completion of the watershed plan in 2003. The NRCS is also one of the key members of the snopack monitoring network (Monahan 2001).

U.S. Fish and Wildlife Service

The USFWS administers the ESA as it pertains to resident fish and all terrestrial species (plants and animals). The FWS also operates the Entiat National Fish Hatchery and conducts annual surveys of spawning spring and summer chinook in the Entiat basin they record sockeye and bull trout data if encountered). Data has been collected in a ~7 mile index reach, from Fox Creek to Dill Creek mouths, since 1962. The USFWS has expanded its efforts since 1994 to include multiple passes of the reach, and to look outside of the index area (Archibald 2001).

United States Forest Service, Wenatchee National Forest, Entiat Ranger District

The Wenatchee National Forest is divided into six geographic administrative units called Ranger Districts. The Entiat subbasin falls within the jurisdiction of the Entiat Ranger District. The District Ranger and staff are responsible for the management, protection, and use of the resources (water, forage, wildlife, habitat, wood, recreation, and minerals) on

these lands to benefit the American people. Resources are managed under the multiple use concept to provide the public with a wide variety of benefits while maintaining and enhancing sustainable ecosystems for future generations (USFS 2001).

Many on-the-ground activities occur on the ranger districts including trail construction and maintenance, operation of campgrounds, and management of vegetation and wildlife habitat. The Forest Service cooperates with State and local governments, forest industries, other private landowners, and forest users in the accomplishment of these activities (USFS 2001):

Tribes

Yakama Nation

The Yakama Nation, also known as the Confederated Tribes and Bands of the Yakama Indian Nation, is a fish and wildlife co-manager of the Entiat basin. The Yakama Nation is responsible for protecting and enhancing treaty fish, wildlife, and other natural resources for present and future generations. The 14 tribes and bands that compose the Yakama Nation ceded over 10 million acres, including the Entiat basin, in the June 9, 1855 treaty with the United States. The Yakama Nation's ceded lands still contain the traditional natural resources upon which the Yakama people depend for subsistence and spiritual and cultural sustenance. They are many and include salmon, deer, elk, huckleberries, and other food and medicinal plants and the most sacred, water.

In the treaty, the tribe reserved rights and responsibilities involving these resources. The treaty's Article 3 states: The exclusive right of taking fish in all the streams, whether running through or bordering said reservation, is further secured to said confederated bands and tribes of Indians, as also the right of taking fish at all usual and accustomed places, in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land. The Entiat basin includes tradition (or "usual and accustomed") fishing areas. As a result of these treaty-reserved rights, the tribe retains substantial governmental authority over activities that affect hunting and fishing. In the 1969 *Sohappy v. Smith /U.S .v. Oregon* decision and the 1974 *U.S. v. Washington* or Boldt decision, the federal courts reaffirmed treaty provisions. These decisions entitle the tribe to one half of the harvestable fish that pass through usual and accustomed tribal fishing grounds. *U.S. v. Washington* rulings include hatchery-bred fish as part of the harvestable population and provide for the protection of the fishery from environmental degradation. The court-ordered *U.S. v. Oregon Columbia River Management Plan* sets harvest, escapement, and production goals pertaining to Indian and non-Indian allocation of anadromous fish resources.

The Yakama Nation, along with the Umatilla, Nez Perce and Warm Springs tribes, developed an anadromous fish restoration plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit: Spirit of the Salmon* (CRITFC 1996). Based on tribal culture and sovereignty as well as science, the plan makes institutional and technical recommendations for Columbia Basin salmon restoration and presents a Entiat subbasin plan, which calls for instream flow restoration,

enforcement of water quality standards and new fish production initiatives to supplement or reintroduce anadromous fish runs, among other measures.

Colville Tribe

The Confederated Tribes of the Colville Reservation, a federally recognized tribe, is located on 1.4 million acres in north central Washington. Many of the names of Colville's 12 aboriginal tribes indicate the geographic range and interest of today's Colville confederation. They include the Nespelem, the San Poil, the Lake, the Palus, the Wenatchi (Wenatchee), the Chelan, the Entiat, the Methow, the southern Okanogan, the Moses Columbia, and others.

Their aboriginal territories were grouped primarily around waterways, including those in the Entiat subbasin as well as many other Columbia Basin watersheds. These watersheds, including the Entiat, contain traditional fishing, hunting and food gathering places still used today by tribal members for subsistence and ceremonial purposes.

The Colville tribe manages natural resources on the reservation and is involved in the management of fish and wildlife and other resources in its aboriginal territory. The tribe's goal is to restore salmon and other native species to their historic habitats in the watersheds of north central Washington. The Colville Natural Resources Department operates more than 10 programs, including Fish and Wildlife, Forestry, and Parks and Recreation.

State

State of Washington

The *Statewide Strategy to Recover Salmon* was released in September 1999, following the Salmon Recovery Planning Act, passed by the legislature in 1998. The Strategy was designed as the state's long-term vision or guide "to restore salmon, steelhead, and trout populations to healthy and harvestable levels and improve the habitats on which fish rely." In December 2000, the Governor and his Joint Natural Resources Cabinet, issued a status report on the Salmon Strategy.

Washington Department of Fish and Wildlife

The mission of the WDFW is to provide sound stewardship of fish and wildlife resources. The WDFW and treaty Indian tribes co-manage the state's salmon populations and are joining with the National Marine Fisheries Service and USFWS to define recovery goals for listed species. In addition to the protection and enhancement of these resources, the department is charged with providing fishing, hunting and other opportunities for public recreation. The Entiat subbasin lies within the agency's north-central district.

Through its Priority Habitats and Species Program, WDFW also provides important fish, wildlife, and habitat information to local governments, state and federal agencies, private landowners and consultants, and tribal biologists for land use planning purposes. PHS information indicates which species and habitat types are priorities for management and conservation; where these habitats and species are located; and what should be done to

protect these resources. In the Entiat subbasin, mule deer, bighorn sheep, mountain goat, blue grouse, bald and golden eagle, waterfowl concentrations, fisher, gray wolf, grizzly bear, lynx, mountain quail, northern goshawk, and northern spotted owl are priorities for conservation and management. Priority habitats within the Entiat subbasin include wetland, snag-rich areas talus slopes meadows, aspen stands, cliffs and bluffs, islands, riparian zones and old-growth/mature forest stands.

Washington Department of Ecology

The mission of the Ecology is to protect, preserve and enhance Washington's environment, and promote the wise management of our air, land and water for the benefit of current and future generations. It goals are to prevent pollution, clean up pollution and support sustainable communities and natural resources.

Ecology is responsible for implementing the federal Clean Water Act and enforcing the water quality standards. In accordance with Section 303(d) of the federal Clean Water Act, every two years the state must identify its polluted water bodies and what type of pollution they suffer from and submit this list to Environmental Protection Agency. The lower Entiat has been on Washington State's 303(d) list since 1992 for exceeding state standards for temperature and pH. Instream flows were added to the list in 1998 (Andonaegui 1999).

Ecology also manages the Watershed Planning Act, passed in 1998 to set a framework to address the state's water resources, water quality and salmon habitat needs, and to establish instream flows. The Ecology has ongoing streamflow and water quality monitoring and management on the Entiat River sub-basin. Instream flows have not been established for the Entiat River, but are the priority task of the Entiat Water Resource Inventory Area (WRIA) Planning Unit (EWPU) (Caldwell and Beecher 1995, Kirk et al. 1995).

The National Marine Fisheries Service (NMFS) in the Columbia River Biological Opinion (Bi-Op) and the Upper Columbia Regional Technical Team (RTT) in it's July 2000 report and draft Regional Recovery Strategy recognize that the establishment and protection of instream flows in the upper Columbia is of paramount importance. The Ecology agrees that instream flows must be established and protected to facilitate restoration of salmonids and other instream values. However, there are not adequate state resources to address instream flows throughout the province. Therefore, Ecology is concentrating its efforts on updating the mainstem Columbia River management program, and is assisting groups organized under the Watershed Planning Act with development of instream flow analyses and plans as part of their watershed plans (Caldwell and Beecher 1995, Kirk et al. 1995).

Ecology has provided ongoing technical and policy assistance to the EWPU. The EWPU has received grant funding for the assessment of water quantity, water quality, habitat, and instream flow resources in the Entiat River sub-basin. The EWPU has already made decisions to use the Instream Flow Incremental Methodology (IFIM) to assess and set flows for the Entiat River sub-basin. The Entiat River sub-basin was assessed by the Ecology using the Physical Habitat Simulation System (PHABSIM) portion of the Instream Flow Incremental Methodology (IFIM). These analyses were completed in 1994 by Brad Caldwell and Hal Beecher. The EWPU has agreed to use the Caldwell and Beecher (1994)

analyses as a foundation for further analyses under the EWPU planning effort. A consultant has been selected, and analyses will be conducted in Water Year (WY) 2002. Additional analyses will need to be completed, and a viable watershed plan must be proposed to change the existing water resource management program. The EWPU is building on the 1995 Draft-Initial Watershed Assessment (Montgomery et al 1995), and other analyses by partners in the watershed. Although habitat, instream flow, water quality, and water quantity projects are ongoing, the EWPU plan is not scheduled for completion until September 2003. Ecology will continue to monitor stream flow and manage water resources based upon the 1995 Draft-Initial Plan (Caldwell and Beecher 1995, Kirk et al. 1995).

Local Government

Chelan County Conservation District

The CCCD is a non-regulatory government agency that matches local resource needs with technical and financial resources, helping landowners put conservation on the ground (WSCC 2001). The CCCD District is the "Lead Agency" of the Entiat watershed planning effort under Washington State's Watershed Planning Act (Chapter 90.82 Revised Code of Washington). The CCCD serves as administrator, coordinator, technical assistance, and facilitator. Through the Entiat WRIA Planning Unit (EWPU, the watershed group formed under the Watershed Planning Act), the CCCD is coordinating the research and development of management recommendations for water resources, water quality, habitat, and instream flow throughout the Entiat watershed (WRIA 46). The CCCD also works with the NRCS, the EWPU and landowners to monitor water resources, and implement aquatic and terrestrial habitat conservation projects. The CCCD also partners with the USFS, USGS, and Ecology to fund installation, operation, and maintenance of streamflow gaging (Monahan 2001).

Tribes and Local Government

Upper Columbia Salmon Recovery Board

The Upper Columbia Salmon Recovery Board is a partnership among Chelan, Douglas, and Okanogan counties, the Yakama Nation, and Colville Confederated Tribes in cooperation with local, state, and federal partners. The mission of the UCSRB is to restore viable and sustainable populations of salmon, steelhead, and other at-risk species through the collaborative efforts, combined resources, and wise resource management of the Upper Columbia Region.

Existing Goals, Objectives, and Strategies

Fish

Shared Goals and Objectives.

The following goals and objectives are shared among more than one organization, however, the individual strategies recommended to achieve those goals and objectives may vary by organization (Andonaegui 1999, CCCD 1999, CRITFC 1995, Mobrand Biometrics 2001, USFS 1996).

Goal 1: Protect or enhance the structural attributes, ecological function, and resiliency of habitats needed to support healthy populations of fish and wildlife.

Objective 1. **Where appropriate, identify and eliminate barriers to spawning and rearing habitat.**

Strategy 1. Reconnect the river to blocked side channels and/or create new side channels to improve rearing habitat conditions.

Strategy 2. Upgrade irrigation structures to meet state standards and reduce damage to fish.

Strategy 3. Inventory and assess the extent to which dams and dikes in the Entiat watershed act as fish passage barriers.

Strategy 4. A culvert barrier study needs to be conducted for the Entiat subbasin and the information incorporated into a database and mapped.

Objective 2. **Restore connectivity, diversity, and function to stream channels and the floodplain.**

Strategy 1. Define and map flood-prone extents so potential and past loss of floodplain capacity can be determined and actions can be taken to restore or protect these areas.

Strategy 2. Identify the factors contributing to the loss of floodplain function for each given reach, and review and select a method for evaluating impaired floodplain functions that addresses causal mechanisms relative to watershed processes.

Strategy 3. Map the Corps of Engineers dike and any other dikes in the Entiat watershed.

Strategy 4. Inventory stream channel crossings and document the manner and extent to which they are acting as constrictions within the meander zone, and affecting sediment and gravel transport, local scour, large wood debris movement, and channel meander within the floodplain.

Strategy 5. Assess the degree to which the Entiat River Road and other roads in the floodplain limit the ability to restore hydraulic processes in the lower 30 miles of the mainstem Entiat River and identify and implement projects to restore a functioning floodplain.

Strategy 6. Evaluate the costs and benefits of restoring salmonid habitat by replacing and maintaining stream components (large woody debris, low vortex rock weirs, bankside root and bole placements) in the floodplain.

Strategy 7. Identify and map stream sections within the Entiat that are dredged and recommend hydrogeomorphically based alternatives. This would include reestablishing a connection to the floodplain where appropriate and/or reducing bedload input in the drainage.

Objective 3. **Protect and Restore Riparian Habitat diversity and function.**

Strategy 1. Loss of the riparian vegetation throughout the system must be stopped and a program of riparian restoration implemented. Chelan County must adopt and enforce an adequate Critical Areas Ordinance pursuant to the Growth Management Act.

Strategy 2. Retain natural areas in developed landscapes, especially undeveloped publicly owned land that contains priority habitats or species. Provide

and plan for a network of greenways/corridors to connect existing natural areas.

Strategy 3. Maintain rural lands and discourage land conversions that are ecologically harmful.

Strategy 4. Reduce urban sprawl; contain residential, commercial, and industrial areas within appropriately designated urban growth areas, and work with county growth management planners to establish lot sizes.

Strategy 5. Limit trails and high-impact recreation facilities in riparian area, retain riparian habitat features at recreation sites, carefully site new facilities, and educate the public on riparian area protection.

Strategy 6. Evaluate the impacts to shade, streambank stability, and large woody debris recruitment due to the loss of large trees within the riparian plant community.

Strategy 7. Exclude livestock from riparian areas or manage them as special use pastures; promote incentives for landowners to restrict unlimited livestock access and develop off-stream sources; intensively manage pastures with riparian habitat; do not graze damaged or sensitive riparian habitat; restore streams damaged by grazing.

Strategy 8. Avoid timber harvest on unstable slopes; implement long rotation cycles of timber harvest; provide corridors connecting riparian and upland habitats.

Strategy 9. Restrict chemical treatments and select sound pest control methods.

Strategy 10. Avoid constructing roads, utility lines, or conducting activities involving stream crossings within riparian zones.

Strategy 11. Secure riparian habitat, riparian bottomland and side channels between the terminal moraine and Fox Creek and those in the lower Mad River, Stormy Creek, and roaring Creek, either through conservation agreements, easements, or direct purchases.

Strategy 12. Strictly control the issuance of hydraulic permits by the state for channel control to ensure there is no additional loss of riparian vegetation due to bank hardening.

Strategy 13. Evaluate whether the impacts of extensive cottonwood root systems to orchardists can be alleviated and riparian function maintained by replacing mature cottonwoods with native shrubby species.

Objective 4. Enhance water quality and quantity.

Strategy 1. The Ecology should stop issuing consumptive water rights, and replace inadequate existing instream flows with more appropriate IFIM-based flows.

Strategy 2. Identify facilities within the Entiat watershed with general and individual wastewater discharge permits and map them into GIS. Record the type and quantity of discharge and assess the extent to which the industrial discharges affect salmonids.

Strategy 3. Map the location of past, present, and planned water quality monitoring stations into GIS along with associated records detailing type and

duration of data collection and the entity responsible for the recording station.

Strategy 4. Continue efforts to rehabilitate and obliterate roads to reduce sedimentation concerns in the Entiat watershed waters as specified by the Entiat Watershed Assessment (USFS 1996) and prioritizations.

Strategy 5. Review county land use and zoning maps, and development regulations to determine the potential impact of development of private lands to salmonids in the Entiat watershed.

Strategy 6. Continue working with the Department of Health and sanitation to maintain current water quality standards.

Strategy 7. Map, with attached data, the active state general permits for stormwater discharge in the Entiat watershed identified in the Needs Assessment for the Wenatchee Water Quality Management Area (DOE 1996).

Strategy 8. Further investigate winter low water temperatures as a factor limiting the ability of the habitat to sustain populations of salmonids.

Strategy 9. Assess wetland function in the Entiat watershed and identify specific wetlands capable of reducing flood flows and frequencies, filtering sediments, nutrients, and toxic chemicals, contributing to the maintenance of instream flows, and providing juvenile salmonid habitat. Direct protection and restoration efforts to those wetlands most crucial to maintaining water quality and salmonid populations.

Strategy 10. Work with landowners to voluntarily maintain or enhance wetland function.

Strategy 11. Determine the extent to which the City of Entiat, the Entiat National Fish Hatchery, and lower Entiat watershed roads contribute to changes in instream water quantity.

Strategy 12. Use the USFS Entiat Watershed Analysis (1996) to draw conclusions regarding the effect road and trail densities, and past grazing impacts on National Forest lands have had on surface water runoff patterns relative to sediment delivery to surface waters.

Strategy 13. Work with NRCS to conserve water used for irrigation including rate and scheduling of application and improvement of systems (micros and ditches).

Strategy 14. Work with Ecology and state lawmakers to determine the feasibility of irrigators using a portion of water saved through conservation practices to expand their base operation.

Strategy 15. Points of diversion for agriculture, off-channel livestock watering, or other uses should be changed or combined, based on channel characteristics and hydrology, to minimize low flows or lack of flows in a given reach of stream.

Strategy 16. Open ditches should be converted to ground water withdrawals or piped systems where it would improve salmonid habitat conditions by decreasing water loss, water temperatures, pathogen/seed pick-up, ditch bank repairs, and side canyon washouts.

Strategy 17. Outline and map areas of valley bottoms that are in continuity with the surface waters to aid in assessing the impact ground water withdrawals have on water availability in the Entiat River.

Strategy 18. Conduct regional water planning to improve water management.

Strategy 19. Create a water conservation trust fund to pay for conservation improvements that will return saved water to instream flows.

Strategy 20. Replace the inadequate existing instream flows with more appropriate IFIM based flows to ensure that the frequency and occurrence of peak flows is similar to that found naturally.

Strategy 21. Control and purify stormwater runoff, and adopt stormwater guidelines.

Strategy 22. Eliminate or severely restrict logging and grazing to prevent sedimentation in the middle and lower reaches of the watershed until the system recovers.

Strategy 23. Pursue alternatives to harmful fertilizers and treat agricultural waste-water.

Strategy 24. Limit accumulations of animal waste near streams and riparian areas.

Strategy 25. Establish baseline data and implement procedures to increase levels of macro-invertebrates.

Strategy 26. Evaluate the extent to which spawned-out salmon carcasses have been removed from the watershed and how this loss of nutrients has affected the ability of the Entiat habitat to fully sustain populations of salmon.

Objective 5. Improve management of road network to minimize impacts to natural habitat.

Strategy 1. Establish general road construction guidelines and develop a road maintenance program.

Strategy 2. Reduce road density and/or cease road construction in inappropriate locations (e.g. near streams, floodplain, riparian areas, and wildlife habitat).

Strategy 3. Close or relocate problematic roads and close unnecessary roads.

Strategy 4. Equip roads that cannot be closed, with crossing structures that can withstand the increased peak flows that follow fires.

Strategy 5. Work with the fire department to assure adequate and reasonable access on federal lands for fire protection and resource needs.

Objective 6. Insure that the operation of Rock Island and Rocky Reach dams have no net impact (NNI) on the salmonid species of concern. The NNI concept takes into account the fact that 100 % survival cannot be achieved at the projects alone, but must also include off-site measures to increase salmonid productivity (Peven 2001).

Strategy 1. Meet a survival standard that mandates a 91 % project (defined as the area that encompasses 1000 ft below a hydropower project to a point 1000 ft below the next upstream dam) survival rate for adults and juveniles be achieved within the geographic area of the projects by fish survival improvements measures, including an independent 95 % juvenile dam (500 ft upstream to 1000 ft downstream of a dam) passage survival (Peven 2001).

Strategy 2. Compensate for the 9 % unavoidable project mortality through hatchery programs (7%) and tributary habitat improvements (2%). The survival standard, hatchery compensation, and habitat improvement combine to provide a 100 % no net impact on the species of concern (Peven 2001).

Objective 7. Identify and minimize negative impacts to salmon habitats by exotic and opportunistic species.

Strategy 1. Determine the extent that genetic alteration and loss of native salmon, and steelhead stocks, through introduced species, acts as a habitat limiting factor.

Strategy 2. Develop a comprehensive weed control program.

Strategy 3. Evaluate the extent to which exotic plant species have displaced native plants, reduced species diversity and plant community complexity, and affects the ability of the habitat to fully sustain populations of salmon.

Strategy 4. Control or eliminate noxious weeds in the Entiat Mountains (Mills Canyon area), Tenas George Canyon, Tommy Creek roaded area, and Mad River Trail area. Prevent further spread to other, non-infested areas using manual, mechanical, and chemical methods. Maintain and enhance biodiversity and habitat integrity in proposed areas.

United States Forest Service

Goal 2: To fully restore or establish an improving trend at degraded locations, based on the desired ecological conditions identified in the USFS Watershed Assessment for the Entiat Analysis Area (USFS 1996).

Objective 1. Restoration of sustainable forest conditions in balance with disturbance regimes.

Strategy 1. Improve sustainability of vegetative components.

Strategy 2. Reduce fuel loadings, especially in urban interface.

Strategy 3. Revegetation of Tyee fire area (trees and understory).

Strategy 4. Promote natural balance of snags and down woody debris.

Strategy 5. Maintenance of large diameter trees.

Strategy 6. Reduce the chance and size of catastrophic wildfires.

Objective 2. Maintain and restore wildlife habitat

Strategy 1. Complete province level wildlife analyses, habitat surveys, and species management plans.

Strategy 2. Complete a dead and defective tree management plan.

Strategy 3. Develop a comprehensive recreation use strategy plan including vegetation management, a site rehabilitation and maintenance program, and an accessibility survey and analysis in concert with access and travel management planning.

Strategy 4. Recover forage species in mule deer winter range.

Strategy 5. Provide sustainable habitat components for all native species.

Yakama Nation and WDFW

Goal 3. To restore a sustainable, naturally producing population of spring and summer chinook, sockeye, and summer steelhead that support tribal and non-tribal harvest and

cultural and economic practices while protecting the biological integrity and the genetic diversity of the subbasin (YN and WDFW 1999).

Entiat Fish Production goals are shown in Table 7 (CRITFC 1995).

Table 7. Entiat anadromous fish production goals

Species	Adult Return Goal
Spring Chinook	200-1,000[1]
Summer Chinook	NE
Steelhead	3,000[1] 1,471[2]
Coho	NE
Fall Chinook	NE
Lamprey	NE

[1] Harvest goal only. Natural production goal not established for spring chinook.
[2] Natural production goal
NE = None Established

Objective 1. Supplement naturally spawning populations to enhance or re-establish natural production.

Spring Chinook

Strategy 1. The Entiat NFH should begin a program to acquire broodstock from the existing natural run.

Strategy 2. Provide rearing and/or acclimation facilities in the natural production areas.

Strategy 3. Determine if the spawning channel located in the upper end of the natural production area could be modified to a semi-natural rearing pond for summer rearing and late fall release.

Summer Chinook

Strategy 4. Change the Eastbank Hatchery (located at Chelan PUD's Rocky Reach Dam) program for summer chinook to provide release of some of the existing production into the Entiat River natural production area, and construct final rearing and/or acclimation facilities.

Steelhead

Strategy 5. Integrate the Chelan Hatchery (located on the Columbia near town of Chelan Falls) steelhead program for the Entiat River with operation of Eastbank and Wells hatcheries. Acclimate releases and develop adult-trapping facilities.

Summer Chinook, Steelhead, and Coho

Strategy 6. Use existing adult traps on the Wenatchee River to trap broodstock for the Entiat River. Once restored, acquire broodstock for the Entiat River from the restored runs.

Goal 4: Study the feasibility of re-establishing a naturally spawning coho population within the mid-Columbia tributaries, while keeping adverse ecological impacts on other salmonid species of concern within acceptable limits (YN and WDFW 1999).

Objective 1. **Determine whether it is feasible to establish a viable localized broodstock for hatchery supplementation in the mid-Columbia.**

Strategy 1. Release coho smolts from a mid-Columbia location and capture returning adults at various established traps with the intent of egg banking at an existing, yet to be determined mid-Columbia facility.

Objective 2. **Evaluate the long-term changes in the genetic and life history profiles of non-native stock of hatchery coho introduced to mid-Columbia River tributaries.**

Strategy 1. Monitor divergence between lower Columbia River hatchery stocks and broodstock used within the mid-Columbia basin to obtain information on traits of adaptive value.

Objective 3. **Evaluate the use of the Turtle Rock Rearing Pond for rearing coho with the release to occur in the Entiat River natural production areas.**

Objective 4. **Modify the Little White Salmon hatchery program to release up to 500,000 coho into the natural production areas of the Entiat River beginning in the year 2002.**

Objective 5. **Develop an environmental Impact Statement on the long-term restoration phase of the coho project.**

Strategy 1. Follow the guidelines as defined the National Environmental Policy Act.

Goal 5: Develop a program to restore lamprey under the leadership of the tribes.

Research, Monitoring, and Evaluation Activities

Fisheries

The Yakama Nation proposes that the following tasks be implemented as part of the ongoing research, monitoring, and evaluation activities in the Entiat subbasin (YN and WDFW 1999, YN 2000):

- Acquire land critical for future stock productivity through purchase or easement.
- Restore degraded habitat and riparian areas important for production.
- Modify land practices that are limiting salmonid production.
- Reintroduce coho to the Entiat basin.
- Provide adequate flows in the Entiat River and its tributaries, especially summer flows on the lower and middle Entiat River.
- Relocate or remove roads in close proximity to streams. Road segments that are causing sediment delivery and channel confinement should be prioritized for work.
- All irrigation diversion structures should be inventoried and evaluated. New and improved fish screening systems should be installed.
- Evaluate effectiveness of supplementation projects, habitat and riparian restoration, and improvement to land management activities.

The USFS, Watershed Assessment for the Entiat Analysis Area (1996) makes the following recommendations with regards to inventory and monitoring priorities:

- Conduct broad stand exam/vegetation condition surveys in unburned and partially burned areas.
- Monitor and analyze availability of forage and cover.
- Track and evaluate vegetation recovery in riparian areas and BAER seeding and native plant recovery response.
- Inventory and monitor plant species of concern (e.g., noxious weeds and sensitive plants).
- Monitor and evaluate road management activities (e.g. use impacts, maintenance needs, closure effectiveness).
- Assess soil quality: results of new ground-disturbing activity and recovery of sites with residual impacts (detrimental soil disturbance).
- Track recreational use impacts on facilities and resources, especially in developed sites and dispersed sites outside of wilderness.
- Inventory unique, critical, and key wildlife habitats (e.g., winter range), and assess the effect of management on these habitats and on species use.
- Inventory and monitor threatened and endangered (e.g., grizzly, bald eagle, peregrines, wolves, and spotted owl), MIS, and sensitive species (e.g., Swakane bighorn sheep population), as per the Wenatchee National Forest and the Northwest Forest Plan.
- Monitor and evaluate snag and down woody debris trends.
- Survey and appraise aquatic habitat conditions: fine sediment deposition, water temperature, stream surveys, and status of fish resources.
- Track water quantity and quality and select parameters to evaluate post-fire conditions and compliance with state standards.
- Monitor and evaluate effectiveness of watershed restoration projects.

The following are draft monitoring and evaluation activities proposed for inclusion in the Entiat Coordinated Resource Management Plan (CRMP) (CCCD 1999). The monitoring plan identifies the elements to be tracked during implementation of this plan to ensure: 1) that natural resource trends remain favorable, (2) that habitat improvements are effective in addressing key limiting factors, and (3) that land use trends do not change significantly from assumed trends, and (4) that the goals and objectives of the CRMP are met. The results of the monitoring and evaluation will allow agencies and landowners to amend the CRMP and /or the Watershed Plan resulting from the 2514 planning process.

Natural Resources

- Chelan County and land management agency records will provide monitoring information on areas occupied by noxious weeds (frequency, 5 years).
- Land management and regulatory agencies will continue to monitor populations of threatened, endangered, and sensitive plants on a three-year basis.
- The U.S. Geological Survey and participating agencies will continue to track instream flow, on an annual basis, via the Ardenvoir and Keystone stream gages. A new gage is scheduled for installation on the Mad River.
- Work with Planning Unit under ESHB 2514 to collect and document information needed to establish base flow. Provide for reevaluation of base flow needs following implementation of restoration work and water conservation measures.

- The Ecology and other management agencies will continue to sample water for water quality (every 3 years) and temperature (establish frequency) parameters. The Ecology has measured water temperatures that exceeded the state Class A standard (64.4^{o}F) on 11 different days between 1984 and 1994. Encourage a refined analysis of water temperature conditions and problem areas in the Ecology assessment.
- The Forest Service will continue sediment sampling to determine if fine sediments exceed established parameters (frequency, establish baseline). This should be accompanied by a more detailed analysis of sediment sources.
- The Natural Resource Conservation Service (NRCS) and other management agencies will conduct stream surveys to monitor geomorphology, riparian vegetation, and streambank erosion for departures from natural conditions (frequency, ~10 years).
- Ecology and WDFW will continue to conduct periodic wetland inventories.
- Management and regulatory agencies will conduct annual redd and dam passage counts to assess whether threatened, endangered and sensitive fish species trends are stable and improving. The WDFW and other regulatory agencies will make similar assessments for wildlife on a five-year basis.
- Study/monitor anchor ice and its effects on all species and life stages of fish, spawning habitat and the relationship to riparian vegetation.
- Studies show low levels of macro-invertebrates in portions of the river system. Work with agencies to establish baseline data and monitor system health.

Habitat Improvements

- NRCS, WDFW, and USFS bench-mark photos and cross-sections with flow data will be used to monitor instream conditions and place instream structures such as rock weirs, and barbs with root wads (frequency, 1 year and 5 year).
- Data from random sampling and bench-mark photos taken by the NRCS, CCCD, and other management agencies will be used to monitor riparian plantings (frequency, 1 year and 5 year).

Land Uses

- Ecology and CCCD air photos and ground-truthing will be use to monitor irrigated lands every five years.
- Management agency records and field counts regarding class and location of livestock will be reviewed on a five-year basis to monitor grazing.
- Records of management agencies and private owners will be reviewed every five years to monitor timber harvest and road building activities.
- Management agency records will be reviewed every five years for visitor days and recreation trends.
- Chelan county records will be monitored annually for the number of exempt wells in new residential housing developments.

Economic and population trends

- The NRCS and CCCD will use data from the 2000 and 2010 US census' to monitor retail sales and population growth trends.

Statement of Fish and Wildlife Needs

Fish

1. Restore access to spawning and rearing habitat.
   a) Reconnect the river to blocked side channels and/or create new side channels to improve rearing habitat conditions.
   b) Upgrade irrigation structures.
2. Protect and restore connectivity, diversity, and function of stream channels and floodplain.
   c) Evaluate costs and benefits of replacing and maintaining steam structures (large wood debris, low vortex rock weirs, bankside root and bole placements) to restore instream complexity and function to floodplain zone.
   d) Identify and map dredged areas in the Entiat River and recommend alternatives to reestablish connection to the floodplain and reduce bedload input in the drainage.
3. Utilize dam passage improvements, hatchery supplementation, and tributary habitat improvements to insure that the Rock Island and Rocky Reach dams have no net impact on salmonid species of concern.
4. Supplement naturally spawning populations of spring and summer chinook, steelhead, and summer chinook to enhance or reestablish natural production.
5. Reestablish a naturally spawning coho population.

Fish and Wildlife

Protect and restore connectivity, diversity, and function of riparian habitat:

6. Protect remaining riparian habitat and restore lost habitat.
   e) Maintain natural habitat areas in urban landscapes and discourage ecologically harmful land conversions to natural and rural lands.
   f) Establish lot sizes and reduce urban sprawl.
   g) Minimize effects of trails, recreation, grazing, and harvest on riparian habitat. Limit these activities, provide incentives and other ecologically sound alternatives, and educate farmers, ranchers and the general public on riparian area protection.
   h) Provide alternatives to harmful chemicals.
   i) Strictly regulate the issuance of hydraulic permits for channel control.
   j) Minimize road and utility line construction in riparian areas.
   k) Secure riparian habitats through conservation agreements, easements, or direct purchases.
7. Restore Water Quality and Quantity
   l) Continue to rehabilitate and obliterate roads to reduce sedimentation.
   m) Maintain water quality standards.
   n) Map active state general permits for stormwater discharge, control and purify stormwater runoff and adopt stormwater guidelines.
   o) Garner the support of landowners in maintaining wetland function.
   p) Conserve water used for irrigation and use saved water to expand the irrigators base operation.

q) Identify and map wastewater discharge facilities and record type and quantity of discharge and impacts on salmonids.
r) Stop issuing consumptive water rights
s) Implement IFIM-based flows.
t) Assess the effects of ground water withdrawal on water availability in the Entiat River.
u) Conduct regional water planning and establish a water conservation trust fund to pay for conservation improvements.
v) Increase macro-invertebrate levels.

8. Establish road maintenance and construction guidelines to minimize impacts to fish and wildlife.
   w) Cease road construction or reduce roads in sensitive areas (near streams, floodplain, riparian areas, and wildlife habitat).
   x) Equip roads that cannot be closed, with crossing structures that can withstand the increased peak flows that follow fires.
9. Control and eliminate exotic and opportunistic species in the Entiat subbasin.
10. Reduce fuel loads, re-vegetate areas damaged by fire, control catastrophic fires, and maintain large diameter tress, snags, and down woody debris in order to restore sustainable forest conditions.

Wildlife Habitat

11. Complete a dead and defective tree management plan.
12. Recover forage species in mule deer winter range.
13. Provide sustainable habitat components for all native species.

Information Needs

14. Inventory and map dams, dikes, channel crossings and culverts in the Entiat subbasin and determine manner and extent to which they limit fish passage.
15. Determine the extent to which roads in the floodplain limit the ability to restore hydraulic processes.
16. Determine prior and potential loss of floodplain capacity.
17. Conduct additional research on the effects of low water temperatures on salmonids.
18. Identify the factors contributing to loss of floodplain function and select a method to evaluate impaired floodplain functions.
19. Assess wetland functions in order to protect and restore those wetlands most capable of enhancing water quality and quantity for salmonids.
20. Determine the extent to which the City of Entiat, the Entiat National fish Hatchery, and lower Entiat watershed roads contribute to changes in instream water quantity.
21. Determine the extent that genetic alteration and loss of native anadromous stocks, and the loss of native plants to exotic species act as habitat limiting factors.
22. Determine if the spawning channel located in the upper end of the natural production area could be modified to a semi-natural rearing pond for summer rearing and late fall release.
23. Study the feasibility of re-establishing a naturally spawning coho population.
24. Determine feasibility of establishing a viable localized broodstock of coho for hatchery supplementation.

Information uncertainties for the Entiat Subbasin noted in the Entiat EDT Watershed Analysis (Mobrand Biometrics, 2001):

25. Verify juvenile life history assumptions for spring and summer chinook.
26. Review and confirm fine sediment ratings.
27. Verify contributions to mortality due to bed scour.
28. Review and confirm ratings for winter conditions and over winter survival, specifically with respect towards water temperatures and contributions of ground water influence.

The Washington Department of Wildlife's Yakama Screen Shop has identified screening projects that require funding in the future (Egbers 2001).

29. The Chelan PUD (Entiat River) project in region 2, district 7, calls for a fish screen replacement. The construction date is not yet scheduled.
30. The screen shop has identified approximately 104 inadequately or unscreened pump diversions in the Entiat and Wenatchee river (reg. 2, Dist. 7), which require new fish screens or replacements. The construction dates are not yet scheduled.

Entiat Subbasin Recommendations

Projects and Budgets

The following subbasin proposals were reviewed by the Columbia Cascade Province Budget Work Group and are recommended for Bonneville Power Administration project funding for the next three years.

Table 1 provides a summary of how each project relates to resource needs, management goals, objectives, and strategies, and other activities in the subbasin.

New Projects

Project: – 29014 – Effects of Impoundment on Fish and Amphibian Habitat Use in Eastern Washington

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Sponsor: Washington Department of Fish and Wildlife (WDFW)

Short Description:

Identify hydrological effects of impoundments on fish and amphibian habitat and habitat use by comparing free-flowing and impounded systems. Focus on off-channel habitat. Enables identification of feasibility of remediation by hydrologic manipulation.

Abbreviated Abstract

We propose to identify the hydrological effects of impoundments on fish and amphibian habitat and habitat use through comparison of impounded and non-impounded systems. Although dam and impoundment effects are well studied, most studies have addressed fish in mainstem and larger-order systems. In contrast, little effort has been devoted to off-channel habitats, which are increasingly recognized as important refuges or nurseries for selected life stages of fishes and amphibians. As the maintenance and connectedness of off-channel habitats is directly influenced by stream hydrology, impoundments that alter hydrology also influence the quality and quantity of off-channel habitats that fishes and amphibians need. We will examine whether quality and quantity or off-channel habitat changes as a function of impoundment-related hydrological alteration for medium-sized streams. Our design includes spatial (above impoundment in same system) and temporal (unimpounded system of similar scale) controls to help identify potential effects. If the impoundment-altered hydrology results in reductions in habitat quality and quantity, alternatives for remediation can be identified. These alternatives will be useful to water managers seeking to maintain off-channel habitat quality and quantity.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
9005300	Investigations of Bull Trout, Steelhead, and Spring Chinook Interactions	Augments information about bull trout and salmonid life history, habitat use and interactions
BPA R174	Bull Trout Assessments in the Columbia River Gorge	Augments information about bull trout
BPA R139	Genetic and Phenotype Catalog of Native Resident Trout of the Interior Columbia Basin Populations in the Upper Yakima Basin	Augments information about bull trout
BPA R66	Yakima River Species Interaction Studies: NTT Response to Supplementation of Steelhead and Salmon in the Upper Yakima Basin	Augments information about bull trout and salmonid life history, habitat use and interactions
199506325	Yakima/Klickitat Fisheries Project Monitory and Evaluation	This project can contribute important data about habitat improvement approaches
199901300	Ahtanum Creek Watershed Assessment	This project can contribute important data about restoring off-channel habitats using hydrologic means
199705300	Toppenish-Simcoe Instream Flow Restoration and Assessment	This project can contribute important data about restoring off-channel habitats using hydrologic means
200001100	Rock Creek Watershed Assessment and Restoration Project	This project can contribute important data about restoring off-channel habitats using hydrologic means
199604000	Evaluation of the Feasibility and Risks of Coho Reintroduction in the Mid-Columbia	This project can contribute to understanding the feasibility and risks of reintroducing coho, a highly off-channel dependent species
198810804	Streamnet: The Northwest Aquatic Information System	This project can contribute significantly to the evaluation and monitoring database, particularly regarding the relationship between off-channel habitats and flows

Relationship to Existing Goals, Objectives and Strategies

NMFS 2000 Biological Opinion and Reasonable and Prudent Alternatives (RPA): This project is action consistent with the NMFS BiOp, for which the major objectives are to minimize take of, and cumulative (including indirect) impacts on, federally listed Pacific salmonids (NMFS 2000), which include spring chinook and summer steelhead in the Middle Columbia River. Project biologists would like to assess the ecological effects of Yakima River dam operations on these salmonids, and attempt to offer mitigation scenarios that would benefit these species. The NMFS BiOp also emphasizes the need to protect critical habitats for these species. Project biologists would examine the different use of OCHs by the three federally listed salmonids in Middle Columbia River and the potential

differing effects of OCH restoration on these species. The NMFS BiOp, under RPA 150, emphasizes funding to protect currently productive non-federal habitat. Regarding habitat-restoration projects in tributaries that might benefit federally listed salmonids, project biologists would focus on OCH integrity in the face of various flow and thermal regimes.

Northwest Power Planning Council, Columbia River Basin Fish and Wildlife Program (NWPPC 2000) This project is action consistent with the vision of the FWP in that it seeks to identify whether adverse effects in off-channel habitats are associated with the hydrology of impoundments systems, and if such adverse effects are identified, to recommend mitigation alternatives. This project also address a key FWP planning assumption calling for management actions that use experimental designs and techniques and integrate research to evaluate hydrological management effects on ecosystems. The OCH project emphasizes four of the scientific principles articulated in the FWP (numbering as indicated in the FWP):

1. "The abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystem," in the case of this project, OCHs.
2. "Habitats develop, and are maintained, by physical and biological processes," in the case of this project, the hydrology which is presumably involved in the dynamic that maintains OCHs.
3. "Ecological management is adaptive and experimental;" in the case of this project an experimental design seeks to identify whether management affecting an altered hydrology influences OCHs.
4. "Ecosystem function, habitat structure and biological performance are affected by human actions;" in the case of this project, the human action of impounding a system may alter the structure of OCHs.

This project addresses all four of the overarching biological objects in the FWP in that it is a project that seeks:

1. To determine an abundant, productive, and diverse community of fish and amphibians is being sustained in context of OCHs.
2. To identify and recommend opportunities for mitigation if alter hydrology is shown to have adverse impacts on OCHs,
3. To ensure that sufficient populations of fish and wildlife will be available for abundant opportunities by helping to guarantee that conditions important to the maintenance of OCHs are not be affected.
4. To promote the recovery of fish and wildlife listed under the Endangered Species Act as two listed fish species, bull trout and coho salmon, are likely to have significant OCH use.

This project also addresses Basin Level Biological Objectives in that it will:

1. Describe the biological performance of different fish and amphibian in context of OCH use.
2. Describe the environmental characteristic of OCHs necessary to favor the maintenance of the fish and amphibian species that use them.

A key aspect of this project is that it has the opportunity to address operational and secondary losses related to the potential degradation of OCHs. This is important as the FWP clearly states that, "Operational and secondary losses have not been estimated or addressed." In context of these potential losses, this project is to address the more specific FWP wildlife objective of maintaining existing and created habitat values. In this case, the project can identify how to maintain OCHs.

Last, this project has a relationship to several of the provisional biological objectives for environmental characteristics at the basin level, which are:

1. Protect the areas and ecological functions that are at present relatively productive for fish and wildlife populations…in this case, OCHs may represent important areas for selected life stages of fishes and amphibians, and may require selected features of the hydrology for their maintenance.
2. Protect and restore freshwater habitat for all life history stages of the key species, and protect and increase ecological connectivity between aquatic areas, riparian zones, floodplains and uplands. In this case, OCHs may be key habitat for selected fish and amphibian life stages that represent a potential ecological bottleneck. Maintenance of OCHs may be the most important mode of ensuring connectivity to main-channel habitats.
3. Allow patterns of water flow to move more than at present toward the natural hydrographic pattern in terms of quantity, quality and fluctuations. This is a focal element of this study, determination of whether alteration of the natural hydrograph through impounded has influence water quantity and fluctuations (seasonally and inter-annually) in a manner than OCHs may be affected.
5. Allow for biological diversity to increase among and within populations and species to increase ecological resilience to environmental variability. In this case, maintenance of OCHs may be important in maintaining biological diversity and the ecological resilience of some fishes and amphibians to seasonal and inter-annual variability.

Review Comments

Not needed for fish but is needed for amphibians. Question urgency. Check coordination. NMFS has identified this as a BiOp project.

Budget

FY2003	FY2004	FY2005
$106,187 Category: Recommended Action	$164,858 Category: Recommended Action	$170,620 Category: Recommended Action

Project: – 29026 – Hanan-Detwiler Passage Improvements

Sponsor: Washington Department of Fish and Wildlife, Yakima Screen Shop (WDFW-YSS)

Short Description:

The Washington Department of Fish and Wildlife/Yakima Screen Shop proposes to complete passage improvements within a side channel of the Entiat River. The side channel is associated with the Hanan-Detwiler irrigation diversion.

Abbreviated Abstract

The Washington Department of Fish and Wildlife/Yakima Screen Shop proposes to complete passage improvements within a side channel of the Entiat River. The side channel is associated with the Hanan-Detwiler irrigation diversion. The project objective is to provide 100 percent protection from mortality and/or injury for all species and life stages of anadromous and resident salmonids, including bull trout, spring chinook, and steelhead that are listed as "threatened" and "endangered" under ESA (6/98, 3/99, and 3/99, respectively).

Relationship to Other Projects

Project ID	Title	Nature of Relationship

Not applicable

Relationship to Existing Goals, Objectives and Strategies

The NWPPC and BPA have made substantial investments in the Columbia River Basin anadromous fish recovery effort. These investments are considered off-site mitigation for losses related to hydroelectric operations in the Columbia River and are predicated on the fact that substantial wild salmon production potential still exists because of large expanses of accessible, high quality spawning and rearing habitat in parts of the basin. This project will provide improved upstream and downstream passage within a side channel to the Entiat River for both adult and juvenile salmonids, believed to be important in improving overall egg-to-smolt survival of critically depressed stocks of naturally produced chinook, steelhead, and bull trout.

NMFS 2000 Biological Opinion & Reasonable and Prudent Alternatives (RPA): The NMFS Biological Opinion (NMFS 2000) encourages the Action Agencies to support a basin-wide Recovery Strategy. The following information is included to demonstrate that this proposal will support the BiOp.

The BiOp lists measures to avoid jeopardy, and gives specific tributary habitat objectives, which include providing passage and diversion improvements, and supporting overall watershed health of riparian and upland habitat. RPA Action 149 addresses passage and screening problems, while initially specifying 3 priority areas (Lemhi, Methow, Upper John Day). It indicates that the program should be expanded, in coordination with NWPPC.

The BOR is designated the lead. At the end of 5 years, work will be underway in at least 15 sub basins (including the Entiat beginning in 2003), with a 10-year window to achieve results.

Northwest Power Planning Council, Columbia River Basin Fish and Wildlife Program (NWPPC 2000) This proposal is consistent with the NWPPC Fish and Wildlife Program, which calls for projects that addresses imminent risk to listed species and projects that have direct benefits, including these:

- Connect patches of high quality habitat or extend habitat;
- Meets multiple priority objectives;
- Collaborative effort with synergistic effects;
- Recommended by an action plan;
- Approved by state or tribal plan.

Examples given in the CBFWA Program include irrigation screens and passage (including culvert replacement) and supporting local ESA recovery efforts.

Entiat Subbasin Summary (Draft 2001): This proposal supports key fish recovery elements described in Section 1 of this subbasin summary, specifically, passage: "Improperly designed water diversions and dams, and unscreened and inadequately screened surface water diversions (pumps and ditches) also pose a direct threat to salmonids." The project addresses the goals and objectives listed in Section 2 of this subbasin summary, specifically: Goal 1, "Protect or enhance the structural attributes, ecological function, and resiliency of habitats needed to support healthy populations of fish and wildlife." Objective 1, "Where appropriate, identify and eliminate barriers to spawning and rearing habitat." Strategy 2, "Upgrade irrigation structures to meet state standards and reduce damage to fish."

The project also addresses the subbasin summary's fish and wildlife needs, specifically, to "restore access to spawning and rearing habitat by reconnect the river to blocked side channels and/or create new side channels to improve rearing habitat conditions and upgrading irrigation structures; to protect and restore connectivity, diversity, and function of stream channels and floodplain; and evaluate costs and benefits of replacing and maintaining steam structures (large wood debris, low vortex rock weirs, bankside root and bole placements) to restore instream complexity and function to floodplain zone."

Upper Columbia Salmon Recovery Board, A Strategy to Protect and Restore Salmonid Habitat in the Upper Columbia Region, A Discussion Draft Report (Upper Columbia Regional Technical Team [RTT] 2001), identifies the following restoration measures in 3.2 Habitat Restoration:

> The highest priority for increasing biological productivity is to restore the complexity of the stream channel and floodplain. The RTT recommends a range of strategies for habitat restoration in the Upper Columbia Region. Examples of restoration measures would include, but not be limited to: screening water intakes to prevent impingement or stranding of juvenile fish (# 4)…and removing passage barriers (# 7).

Review Comments

Needs better development of M&E. USFWS are currently performing spawning surveys in the Entiat subbasin. The reviewers do not believe that the contingency funds proposed are BPA fundable. NMFS has identified this project as a BiOp project.

Budget

FY2003	FY2004	FY2005
$85,000 Category: High Priority	$5,000 Category: High Priority	$5,000 Category: High Priority

Project: – 29027 – Comprehensive Inventory and Prioritization of Fish Passage and Screening Problems in the Wenatchee and Entiat Subbasins

Sponsor: Washington Department of Fish and Wildlife, Yakima Screen Shop (WDFW-YSS)

Short Description:

Locate and evaluate all culverts, dams, fishways, water diversions, and other human-made features in the Wenatchee and Entiat subbasins, conduct habitat assessments, and prioritize all barriers and unscreened or inadequately screened water diversions.

Abbreviated Abstract

The Washington Department of Fish and Wildlife/Yakima Screen Shop proposes to conduct a watershed-based inventory of all fish passage barriers and unscreened or inadequately screened water diversion in the Entiat and Wenatchee sub basins. All fish bearing streams will be walked and each human-made feature (culverts, dams, fishways, water diversions, and other) encountered will be assessed and prioritized following the protocols outlined in the *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000). Habitat assessments will be conducted beginning with the first barrier encountered and continue upstream until the stream is no longer fish bearing. The data collected in this inventory will be stored in SSHEARbase, the statewide fish passage and screening database developed and maintained by Salmonid Screening, Habitat Enhancement and Restoration Section (SSHEAR) staff in Olympia.

Relationship to Other Projects

Project ID	Title	Nature of Relationship
	Columbia Cascade Province Pump Screening	This project will provide current information to the existing pump screen inventory.

Relationship to Existing Goals, Objectives and Strategies

The NWPPC and BPA have made substantial investments in the Columbia River basin anadromous fish recovery effort. These investments are considered off-site mitigation for

losses related to hydroelectric operations in the Columbia River, and are predicated on the fact that substantial wild salmon production potential still exists because of large expanses of accessible, high quality spawning and rearing habitat still exists in parts of the basin. This project will identify where high priority fish passage projects could be undertaken to increase fish distribution and production in the watersheds, and identify high priority screening projects to improve juvenile fish survival, which is believed to be important in improving overall egg-to-smolt survival of critically depressed stocks of naturally produced chinook, steelhead, and bull trout.

These surveys tie directly to other efforts being conducted within these watersheds by providing prioritization of corrections, and assessment of habitat conditions. The Fish Passage Task Force and the Salmon Recovery Funding Board have sanctioned this protocol. This protocol is also listed as a source of information in the Joint Natural Resources Cabinet's *Guidance on Watershed Assessment for Salmon,* an October 15, 2001 publication. The information from this protocol is a key element in WDFW's Salmon and Steelhead Habitat Inventory & Assessment Program and in the Ecosystem Diagnostic & Treatment (EDT) model being used in the Columbia Basin Salmon Recovery efforts at the watershed level.

NMFS 2000 Biological Opinion & Reasonable and Prudent Alternatives (RPA) The Biological Opinion (BiOp) encourages the Action Agencies to support a basin-wide recovery strategy (NMFS 2000). The following information is included to demonstrate that this proposal will support the BiOp.

The BiOp lists measures to avoid jeopardy and gives specific tributary habitat objectives, which include providing passage and diversion improvements and supporting overall watershed health of riparian and upland habitat.

RPA Action 149 addresses passage and screening problems. While initially specifying 3 priority areas (Lemhi, Methow, Upper John Day), it indicates that the program should be expanded, in coordination with NWPPC. The BOR is designated the lead. At the end of 5 years, work will be underway in at least 15 subbasins (including the Entiat beginning in 2003, and the Wenatchee beginning in 2004), with a 10-year window to achieve results.

Entiat Limiting Factors Analysis (Andonaegui 2001) In an assessment of causes of fish blockages, the Limiting Factors Analysis calls for an "inventory of these dams or dikes that act as fish blockages…to be conducted in the Entiat watershed" and for "a culvert barrier survey…to be completed in this watershed." It also notes that no prioritization of barrier removals exists and that a "list needs to be developed."

Entiat Subbasin Summary (Draft 2001) supports this project. As called for in Section 2, Goal 1, Objective 1, Strategies 3 and 4, this project would "[i]nventory and assess the extent to which dams and dikes in the Entiat watershed act as fish passage barriers (Strategy3) and identify culvert barriers and map and the incorporate the information into a database (Strategy 4).

Wenatchee Subbasin Summary (Draft 2001) supports this project. As called for in Section 2, Goal 4, this project would "increase the information and knowledge needed to protect, restore, and manage fish, wildlife and their habitats." By completing an inventory of fish barriers and prioritizing fish passage problems, this project addresses Goal 4, Objective 1, Strategy 11, (which states "complete watershed-based inventories and prioritization of fish passage problems").

Upper Columbia Salmon Recovery Board, A Strategy to Protect and Restore Salmonid Habitat in the Upper Columbia Region, A Discussion Draft Report (Upper Columbia Regional Technical Team [RTT] 2001), identifies the following restoration measures in 3.2 Habitat Restoration:

> The highest priority for increasing biological productivity is to restore the complexity of the stream channel and floodplain. The RTT recommends a range of strategies for habitat restoration in the Upper Columbia Region. Examples of restoration measures would include, but not be limited to screening water intakes to prevent impingement or stranding of juvenile fish…and removing passage barriers.

Review Comments

Assure work is coordinated with Chelan County. The reviewers recommend reducing the staff proposed by 1 FTE and find other sources for the 2 4x4 pickup trucks in 2003. The budget has been reduced to reflect these changes. NMFS has identified this project as a BiOp project.

Budget

This project will be funded in the Wenatchee Subbasin (see Wenatchee Subbasin Summary).

Table 8. Subbasin Summary FY 2003 - Funding Proposal Matrix

Project Proposal ID	29014	29026	*29027
Provincial Team Funding Recommendation	Recommended Action	High Priority	High Priority
Goal 1: Protect or enhance the structural attributes, ecological function, and resiliency of habitats needed to support healthy populations of fish and wildlife.		X	X
Objective 1.Where appropriate, identify and eliminate barriers to spawning and rearing habitat.		X	X
Objective 2.Restore connectivity, diversity, and function to stream channels and the floodplain.			
Objective 3.Protect and Restore Riparian Habitat diversity and function.			
Objective 4.Enhance water quality and quantity.			
Objective 5.Improve management of road network to minimize impacts to natural habitat.			
Objective 6.Insure that the operation of Rock Island and Rocky Reach dams have no net impact (NNI) on the salmonid species of concern. The NNI concept takes into account the fact that 100 % survival cannot be achieved at the projects alone, but must also include off-site measures to increase			

Project Proposal ID	29014	29026	*29027
salmonid productivity (Peven 2001).			
Objective 7.Identify and minimize negative impacts to salmon habitats by exotic and opportunistic species.			
Goal 2: To fully restore or establish an improving trend at degraded locations, based on the desired ecological conditions identified in the USFS Watershed Assessment for the Entiat Analysis Area (USFS 1996).	X		
Objective 1.Restoration of sustainable forest conditions in balance with disturbance regimes.			
Objective 2.Maintain and restore wildlife habitat.	X		
Goal 3. To restore a sustainable, naturally producing population of spring and summer chinook, sockeye, and summer steelhead that support tribal and non-tribal harvest and cultural and economic practices while protecting the biological integrity and the genetic diversity of the subbasin (YN and WDFW 1999).			
Objective 1.Supplement naturally spawning populations to enhance or re-establish natural production.			
Goal 4: Study the feasibility of re-establishing a naturally spawning coho population within the mid-Columbia tributaries, while keeping adverse ecological impacts on other salmonid species of concern within acceptable limits (YN and WDFW 1999).			
Objective 1.Determine whether it is feasible to establish a viable localized broodstock for hatchery supplementation in the mid-Columbia.			
Objective 2.Evaluate the long-term changes in the genetic and life history profiles of non-native stock of hatchery coho introduced to mid-Columbia River tributaries.			
Objective 3.Evaluate the use of the Turtle Rock Rearing Pond for rearing coho with the release to occur in the Entiat River natural production areas.			
Objective 4.Modify the Little White Salmon hatchery program to release up to 500,000 coho into the natural production areas of the Entiat River beginning in the year 2002.			
Objective 5.Develop an environmental Impact Statement on the long-term restoration phase of the coho project.			
Goal 5: Develop a program to restore lamprey under the leadership of the tribes.			

These projects are referenced by ID above:
29014 – The Effects of Impoundment on Fish and Amphibian Habitat Use in Eastern Washington
29026 – Hanan-Detwiler Passage Improvements
*29027 – Comprehensive Inventory and Prioritization of Fish Passage and Screening Problems in the Wenatchee and Entiat Subbasins
* Note: Project 29027 will be funded in the Wenatchee Subbasin.

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Appendix A.

Agriculture, Fish, and Wildlife Tour, June 19, 2001 Draft Revision