3.4.2.3 Voluntary Regional Agreements

Volunteer Regional Agreements (VRAs) could be formed anywhere in the Columbia River Basin. The surface water quality for VRAs would be the same as described above for the Columbia River Basin (see Section 3.4.2).

3.5 Ground Water

Washington state defines ground water as:

> . . . all waters that exist beneath the land surface or beneath the bed of any stream, lake or reservoir, or other body of water within the boundaries of this state, whatever may be the geological formation or structure in which such water stands or flows, percolates or otherwise moves . . . (RCW 90.44.035).

Ground water is underground water found in pore spaces between grains of soil or rock or within fractured rock formations. Ground water typically originates as precipitation that infiltrates through soil and underlying unsaturated geologic materials until reaching the water table. The saturated zone is referred to as an aquifer when it is capable of yielding sufficient water to a supply well. Saturated zones composed of coarse sands and gravels or those occupying large fractures in bedrock are generally the most productive aquifers. An aquifer is recharged by the process of infiltration and percolation of water to the zone of saturation (Ecology and WDFW 2004).

Surface water bodies and aquifers, particularly shallow aquifers, are often interconnected. Stream flow derived from ground water discharge during low-flow periods is referred to as baseflow. Baseflow is important in maintaining year-round flow in streams fed by rain and snowmelt runoff (Hermanson 1991).

Ground water in the Columbia River Basin in Washington is predominantly associated with the flood basalts of the Columbia River Basalt Group, but also with sediments that overlie or are interbedded with the basalts. The entire aquifer system underlies approximately 50,600 square miles of the Columbia Plateau in Washington, Oregon, and parts of northwest Idaho (Figure 3-11) (Bauer 2000).

A large portion of this area is included in the Central Columbia Plateau/Yakima River Basin National Water-Quality Assessment study unit that has generated numerous ground water technical investigations by the USGS. Work in the study unit is intended to focus on separating the mechanisms and effects of various agricultural management practices on ground water, surface water, and stream ecosystem conditions to characterize how natural and anthropogenic chemicals move through the hydrologic system. This information is intended to help local, regional, state, and federal land managers produce sound decisions regarding water and land management within the study area.

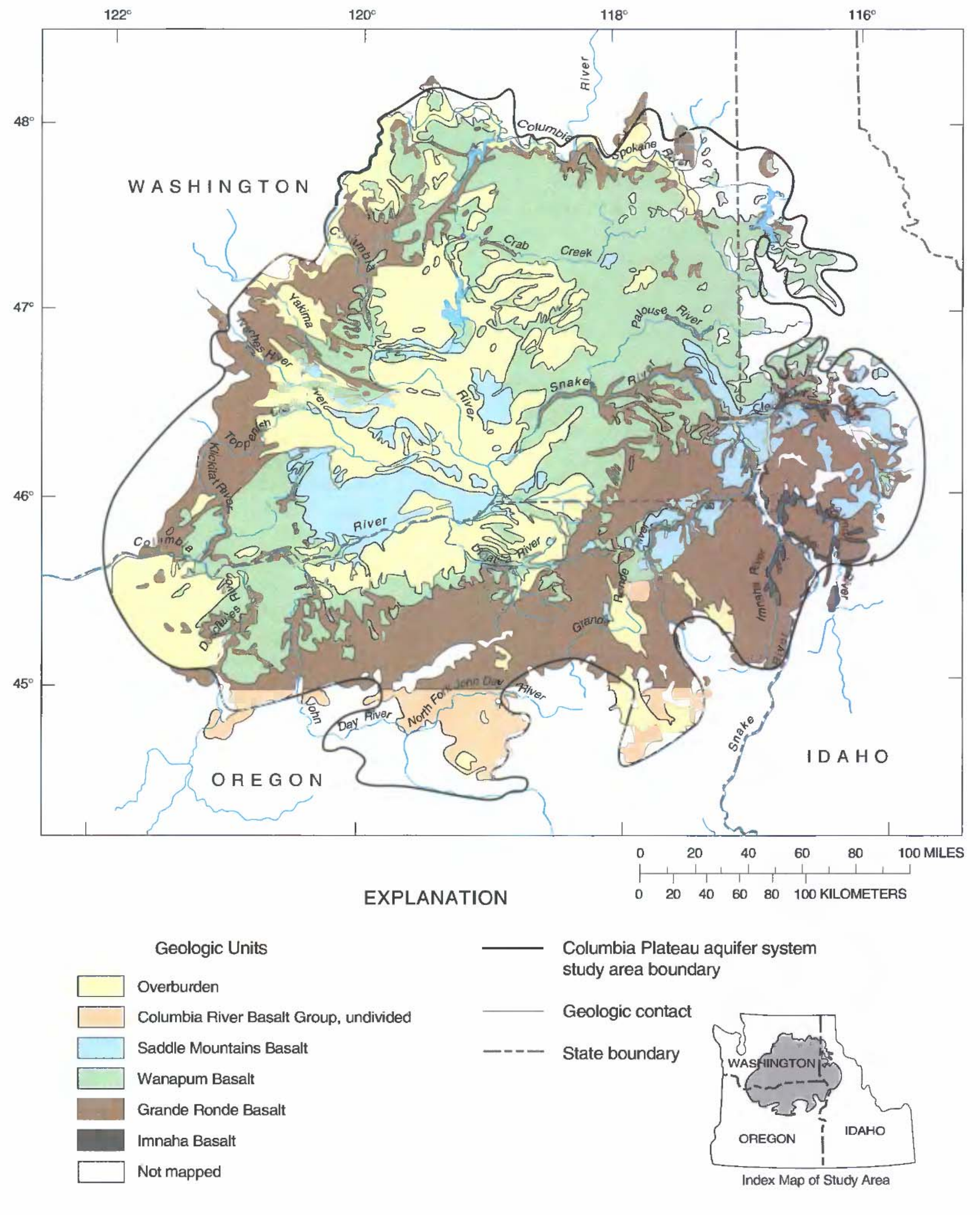

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FIGURE 3-11

LOCATION OF THE COLUMBIA PLATEAU REGIONAL AQUIFER SYSTEM

COLUMBIA RIVER WATER MANAGEMENT PROGRAM EIS

WASHINGTON

3.5.1 Ground Water Quantity

In general, recharge to the deep, confined basalt aquifers is less than 1 inch per year, but in some irrigated areas, recharge can be as great as 10 inches per year (Bauer 2000). Results from a ground water model developed for three areas of the Columbia Basin Project indicated that between 1952 and 1958, ground water storage within the project increased by approximately 7.25 million acre-feet in the upper aquifer and 66,000 acre-feet in the lower aquifer (Reclamation 1982). Model results also indicated that the rate of increase in ground water storage was beginning to level off. This recharge supports a variety of beneficial uses. Large production wells are usually completed within the deep, confined basalt aquifer systems because of their high-yield capacity and good water quality. These aquifer systems are usually found in the Grande Ronde Formation of the Columbia River Basalt Group. More than 80 percent of drinking water in the mid-Columbia River Basin comes from ground water. The largest ground water users are irrigators in the Central Columbia Plateau area (Jones and Wagner 1995). Ground water is pumped from the Odessa aquifer to irrigate about 170,000 acres; issues associated with this use are discussed in Section 3.5.3.1. Ecology's rule, Chapter 508-14 WAC, which specifically addresses ground water management within the Columbia Basin Project and outside of the Quincy and Odessa Ground Water Management Subareas, is discussed in Section 3.6.1.2.

Ground water levels in shallow portions of the aquifer system have risen in areas where surface water is brought in for agriculture. Leakage from irrigation canals and other water that is not used consumptively by crops reaches the shallow water table and increases shallow ground water levels. Shallow water levels have increased in the Quincy and Pasco basins by 150 feet or more since development (Jones and Wagner 1995). Ground water levels in deeper portions of the aquifer system have declined as a result of ground water being pumped for irrigation and municipal supply. Areas east of the Columbia Basin Project have experienced ground water declines of more than 100 feet, while portions of Grant County near the Columbia River have experienced ground water declines of up to 450 feet (Whitehead 1994; Jones and Wagner 1995).

3.5.2 Ground Water Quality

Ecology's *2001 Water Quality Assessment*, an update to the 2000 Clean Water Act Section 305(b) Report (Ecology 2005c), concluded that generally, ground water quality in Washington is "good." Where ground water quality problems occur, the assessment attributed the problems primarily to nitrates, pesticides, metals, and other types of non-point pollution. Non-point pollution is created by diffuse land and water use activities such as use of onsite sewage disposal systems, commercial and non-commercial use of pesticides and fertilizer, and management of stormwater runoff (Ecology and WDFW 2004).

In Adams, Franklin, and Grant Counties, nitrate concentrations exceed the EPA maximum contaminant level for nitrate in about 20 percent of all drinking water wells (Ryker and Frans 2000).

Nitrate concentrations in the Central Columbia Plateau's ground water have generally increased since the 1950s. Although fertilizer application leveled off in about 1985, it is too early to be certain of any corresponding leveling off or decrease in nitrate concentrations in the regional ground water system (Williamson et al. 1998). Pesticides are present in more than half of the wells in the Central Columbia Basin Plateau that contain elevated nitrate concentrations (above the "natural" or background level of 2-3 mg/L) (Williamson et al. 1998).

3.5.3 Early Action Study Areas

3.5.3.1 Lake Roosevelt Drawdown

Ground water movement from the end of Grand Coulee is controlled by an impervious basalt ridge between Soap Lake and Rocky Ford Spring. Surface and ground water north of this ridge flow toward Soap Lake (Blanchard 2006). Lake Roosevelt is the primary source of irrigation water for the Columbia Basin Project. The water from the additional drawdown will be used to augment streamflows below Lake Roosevelt and to partly replace ground water use in the Odessa Subarea. Because the application of water to the Odessa Subarea has the potential to affect ground water, ground water conditions in the Odessa Subarea are described here. Reclamation has initiated a study of the Odessa Subarea and developed a Plan of Study for the area (Reclamation 2006c,d).

Approximately 121,000 acres of the Odessa Subarea underlies the easternmost portion of the authorized Columbia Basin Project (see Figures 1-1 and 2-1). Most of the ground water is pumped from deeper water-bearing zones in the Columbia River Basalt Group.

Irrigation wells primarily pump water from aquifers at a depth of 500 to 1,000 feet below the ground surface (Luzier and Skrivan 1975). The deep aquifers are generally permeable and can sustain high levels of pumping. Based on an estimate by the Columbia Basin Development League (2005), about 170,000 acres are irrigated by ground water in the Odessa Subarea.

Ecology began permitting irrigation wells in the Odessa Subarea in the 1960s and 1970s while anticipating the completion of the Columbia Basin Project. Irrigators were advised that this source would not be permanent, but anticipated that the Columbia Basin Project would continue to be developed and eventually replace ground water with surface water. Significant declines (e.g., 40 feet between March 1967 and March 1971) in the water level prompted Ecology to designate the Odessa Subarea as a ground water management area (WAC 173-128A, 130A; Luzier and Skrivin 1975). The purpose of the management area designation was to control the rate of decline of ground water. The declining aquifer is not only of concern to irrigators, but also municipalities in the Odessa Subarea that rely on the aquifer for municipal and industrial water supply.

Ground Water Quality

In addition to water level declines, there are water quality concerns associated with the continued use of deep ground water in the Odessa Subarea such as high water temperatures and mineral content. At this time, there do not appear to be any published water quality studies that report quality data for the Odessa Subarea. Both water quality and quantity concerns prompted Reclamation's study on the use of water from Lake Roosevelt to replace ground water in the Odessa Subarea (Reclamation 2006c,d).

3.5.3.2 Supplemental Feed Route

The ground water system underlying the Supplemental Feed Routes is located in the Columbia River Basalt Group (see Sections and 3.5.1 and 3.5.3.1 for more detail). Surface water sources interact on a local level with the shallow ground water system. Ground water contributes almost 100 percent of the Frenchman Hills Wasteway's baseflow (Williamson et al. 1998). Shallow ground water in the unconfined aquifer flows into Moses Lake along the northwestern and eastern shores (Ecology 2003c). The Potholes Reservoir also influences the direction of ground water flow (Luzier and Burt 1974).

Water quality degradation associated with shallow ground water results from land use practices that introduce excessive pollutants into the ground water through infiltration. Nitrate concentrations in the ground water flowing into the Frenchman Hills Wasteway increased between 1966 and 1990 (Williamson et al. 1998). See Section 3.5.2 for a more detailed discussion of ground water quality in the Columbia Basin Plateau.

Nitrate concentrations in the ground water flowing into the Frenchman Hills Wasteway increased between 1966 and 1990 (Williamson et al. 1998).

3.5.3.3 Columbia-Snake River Irrigators Association Voluntary Regional Agreement

The ground water quality affected by the CSRIA VRA would be the same as for the Management Program (see Section 3.5.2).

3.6 Water Rights

There are several special water rights issues related to the Columbia River Basin in Washington that will be involved in implementation of the Management Program. These issues are described in this section. A general discussion of water rights in Washington is included in Appendix D.

3.6.1 Special Water Rights Issues in the Columbia River Basin

3.6.1.1 Instream Flows/Interruptible Rights

Prior to 1980, there were no instream flows set for the Columbia River. In 1980, Ecology adopted an administrative rule that provided that new water rights would be conditioned upon the flows set by the rule (Chapter 173-563 WAC). Water rights conditioned on instream flows are called “interruptible rights” because the use of the right is subject to being interrupted when forecasted river levels fall below established flows. Domestic and municipal rights were exempt from the rule. Ecology amended the rule in 1998 and provided that all water right applications filed after July 27, 1997, would be subject to evaluation for impacts on fish as well as existing water rights. Ecology is directed to consult with “appropriate local, state, and federal agencies and Indian tribes” in determining whether there would be an impact on fish (WAC 173-563-020(4)). Any permit Ecology approves may be subject to instream flow protection or mitigation as necessary, determined case-by-case (WAC 173-563-020(4)). In addition to surface water permits, this condition may be included in ground water permits that are in hydraulic continuity with the mainstem[2].

A water right is subject to interruption if the source stream falls below flow levels established by state administrative rules. A water right is not subject to interruption based on flows in the federal Biological Opinions issued under the Endangered Species Act (ESA), although such flows are a consideration when Ecology issues a new water right or makes a decision on a change application.[3] To date, Ecology issued approximately 340 interruptible water rights on the Columbia River mainstem subsequent to the adoption of an instream flow rule for the river in 1980 (Ecology, personal communication, 2006). Table 3-14 summarizes the interruptible water rights issued by Ecology.

Table 3-14. Water Right Permits and Certificates Within One-Mile Zone of Columbia and Snake Rivers Junior to Instream Flows

Purpose of Use	Surface Water			Ground Water		
	Number of Water Rights	Q_i (cfs)	Q_a (acre-feet/year)	Number of Water Rights	Q_i (gpm)	Q_a (acre-feet/year)
Columbia River						
Commercial and industrial	1	2	50	1	1,200	1,113
Commercial, industrial, domestic	--	--	--	3	3,315	1,553
Domestic, irrigation and related uses*	11	77	1,374	23	12,634	4,782
Domestic and related uses*	5	0.1	7	4	1,785	508
Irrigation and related uses*	202	678	117,931	80	151,067	45,964
Commercial, industrial and irrigation	3	12	3,956	1	1,500	1,600
Domestic, irrigation, industrial, commercial and related uses*	1	1,140	214,000	--	--	--
Municipal	--	--	--	2	512	150
Power	3	213,400	0	--	--	--
Columbia River Total	226	215,309	337,318	114	172,013	55,670

[2] Chapter 173-564 WAC, adopted in 1993, instituted a moratorium on any new water rights from the Snake River within Washington State. The rule included a sunset provision which stated that the section imposing the moratorium would expire on July 1, 1999, or upon adoption of instream flows for the mainstem Snake River, whichever occurred first (WAC 173-564-040(6)). No instream flows were set by July 1, 1999, and, therefore, the moratorium expired. Ecology has yet to adopt instream flows for the Snake River.

[3] Section 7(a)(2) of the ESA requires federal agencies to consult with National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitats. The NMFS issued Biological Opinion determined the flows needed for the threatened and endangered salmonid species in the Columbia River. These Biological Opinion flows are products of the consultation between NMFS and the federal agencies (BPA, BOR, and the U.S. Army Corps of Engineers) responsible for the configuration, operations, and maintenance of 14 sets of dams, powerhouses, and associated reservoirs on the mainstem of the Columbia and Snake Rivers known collectively as the FCRPS. *See* discussion of Biological Opinion flows in sections 3.6.1.6.

Purpose of Use	Surface Water			Ground Water		
	Number of Water Rights	Q_i (cfs)	Q_a (acre-feet/year)	Number of Water Rights	Q_i (gpm)	Q_a (acre-feet/year)
Snake River						
Irrigation and related uses*	25	398	87,978	6	12,170	7,540
Domestic	1	2	1	--	--	--
Snake River Total	26	400	87,979	6	12,170	7,540
Columbia and Snake River Total	**252**	**215,709**	**425,296**	**120**	**184,182**	**63,211**

Source: Ecology, personal communication, 2006.

*Related uses may include a combination of any of the following: fire protection, frost protection, heat protection for crops, stock water, cooling for industrial purposes, recreation/beautification, instream flow, and trust water.

Uninterruptible rights are preferred over interruptible rights because uninterruptible rights provide the water user with greater security that they will be able to divert their water every year. This security is especially important for irrigators in the Columbia River Basin who need to sustain their crops each year. However, uninterruptible water rights are not a guarantee that the user will be able to divert all the water they need because they may still be junior to another water right holder in the system (National Research Council 2004).

The Columbia River instream flow rule allows the director of Ecology to reduce the minimum instantaneous and/or average weekly flows for the Columbia River established in the rule by 25 percent if the director "deems it to be an overriding public interest requirement" to do so (WAC 173-563-050(1)).[4]

The rule also authorizes the director to approve future uses of water that would conflict with the provisions of Chapter 173-563 "only in those situations when it is clear that overriding considerations of public interest will be served" (WAC 173-563-080). This decision is to be made in consultation with the directors of the Washington Department of Fish and Wildlife (WDFW) and the state Department of Agriculture, and the state Commissioner of Public Lands.

Consideration of the public interest by the director of Ecology shall include an evaluation of all uses of the river and their impact on the state of Washington. The uses to be considered include, but are not limited to, uses of water for domestic, stock watering, industrial, commercial, agricultural, irrigation, hydroelectric power production, mining, fish and wildlife maintenance and enhancement, recreational, thermal power production, and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the state (WAC 173-563-080).

Ecology established a reservation of water in the John Day/McNary Pools for future irrigation use and future municipal use (Chapter 173-531A WAC). Permits issued for these uses from the Pools after July 27, 1997, are subject to the same consultation requirements as other water right applications under WAC 173-563-020(4) and WAC 173-531A-060.

[4] In no case may the outflow from Priest Rapids Dam fall below 36,000 cfs (WAC 173-563-050(1)).

3.6.1.2 Columbia Basin Reclamation Project

The Columbia Basin Project is a major consideration in any decisions regarding management of the Columbia River.[5] The Columbia Basin Project is a federally authorized project with multiple purposes: irrigation, power production, flood control, municipal water supply, recreation, and fish and wildlife benefits. The Columbia Basin Project was authorized for 1,029,000 irrigated acres and currently provides water to approximately 671,000 acres. Water is provided to three irrigation districts: Quincy-Columbia Basin Irrigation District, East Columbia Basin Irrigation District, and South Columbia Basin Irrigation District. These districts in turn deliver water to their members (Blanchard, personal communication 2006).

Reclamation holds state-based water rights, which entitle Reclamation to store and deliver water for the multiple purposes of the Columbia Basin Project (RCW 90.40.030, RCW 90.40.090). Reclamation is authorized to deliver up to 3,158,000 acre-feet of water per year at full build-out of the Columbia Basin Project. The water withdrawn from appropriation by Reclamation for development of the Columbia Basin Project is withdrawn until "the project is declared complete or abandoned by the United States" (RCW 90.40.100). The water rights held by Reclamation are presented in Table 3-15. Reclamation will still need to acquire permits and address issues under NEPA and ESA consultation before diverting additional water for the Columbia Basin Project (National Research Council 2004).

Table 3-15. Bureau of Reclamation Columbia Basin Project Water Rights, Permits, and Withdrawals

Certificate/Permit/ Application	Priority Date	Quantity	Purpose
Irrigation			
S3-01622C	5/16/1938	13,450 cfs 2,910,000 acre-feet/year	Irrigation of 590,000 acres, hydroelectric, recreation, municipal, industrial
C-9252	12/24/1941	40 cfs	Irrigation of 1,319 acres, Block 2
S300019C	4/22/1943	212 cfs 70,000 acre-feet/year[1]	Partial irrigation of 160,000 acres
C-10703	10/27/1958	80 cfs 23,121 acre-feet/year	Irrigation of 3,303 acres, Block 3
R3-00013P	4/22/1943	200,000 acre-feet[2] plus storage of project waste, seepage, and return flow	Supplemental supply; irrigation of 234,000 acres
S3-25062C	10/27/1958	8.5 cfs 23,121 acre-feet/year	Irrigation of 350 acres, Block 3
S3-28586P	5/16/1938	1,140 cfs 214,000 acre-feet/year	Irrigation, hydroelectric, recreation, municipal, industrial
Columbia Basin Project Withdrawal	5/16/1938	10,410 cfs	Reserved for remainder of Columbia Basin Project
Withdrawal	6/16/1975	120 cfs	Block 1

[5] The CBP was authorized by the Columbia Basin Project Act, 57 Stat. 14 (1943), 16 U.S.C. 835 (1958).

Certificate/Permit/ Application	Priority Date	Quantity	Purpose
Hydropower			
C-11543	5/16/1938	75,000 cfs continuously	Hydropower left and right bank of Grand Coulee Dam
C-11793	5/16/1938	6,400,000 acre-feet	Live storage, FDR irrigation – hydropower
C-11794	8/12/70	3,162,000 acre-feet	Dead storage FDR
S3-26257C	5/9/75	22,000 cfs continuously	Hydropower – 3rd power plant - increased capacity
S3-26258C	10/16/69	184,000 cfs continuously	Hydropower – 3rd power plant - six units
S3-27615C	10/16/69	7,400 cfs continuously	Hydropower - four pump turbine units
S3-01606C	10/16/69	21,700 cfs continuously	Hydropower - increased capacity left and right bank - Grand Coulee (18,000 cfs), two pump turbines (3,700 cfs)
S3-01622C (Old Permit #15994)	5/16/38	13,450 cfs continuously March through October	Low head power generation
R3-00013P	4/22/43	200,000 ac-ft	Low head power generation

cfs = cubic feet per second; ac-ft/yr = acre-feet per year
[1] From Lind Coulee
[2] Natural flows from Rocky Ford, Upper Crab Creek, tributaries to Moses Lake, and Potholes Reservoir

Return flows from irrigation water delivered by Reclamation belong to Reclamation as long as the water is within the boundaries of the Columbia Basin Project. Once it leaves the boundaries of the project, the water continues to belong to Reclamation as long as it is under the "possession and control" of the agency (*Ecology v. Bureau of Reclamation*, 118 Wn.2d 761, 827 P.2d 275 (1992)).

Ecology has adopted a rule that specifically addresses ground water within the Columbia Basin Project outside of the Quincy Ground Water Management Subarea (Chapter 173-124 WAC), and the Odessa Ground Water Management Subarea (Odessa Subarea) (Chapter 173-128A WAC, WAC 508-14-030). In the rule, Ecology recognizes that all natural ground water and "all 'artificially stored' ground waters that have been abandoned or forfeited are public waters available for appropriation[.]" Beneath the surface of the Columbia Basin Project, naturally occurring ground water and artificially stored ground water have become commingled, and it is unknown how much is abandoned and available for appropriation. Therefore, Ecology may issue permits for withdrawal of ground water in this area subject to the condition that if Ecology subsequently discovers that there is not the quantity of ground water available that it now believes, Ecology may withdraw or modify the permit. No certificates may be issued until Ecology makes a more definitive determination of the availability of public waters (WAC 508-14-030(2)).

3.6.1.3 Tribal Rights in the Columbia River Basin

Tribal federal reserved water rights are a critical piece of the water rights picture wherever they occur. The tribal rights for out-of-stream uses have as a priority date the date the reservation was established. The rights are usually the most senior on the river and superior to all subsequently established rights. The priority date for water rights for fish is time immemorial. Tribal rights are largely unquantified and include a potentially large future increment of water under the practicably irrigated acreage (PIA) standard. Although not quantified, tribal water rights for instream flow are rights to a quantity of water necessary to maintain a fishery and protect the tribes' right to fish. Tribal rights are not subject to relinquishment. The number of tribes in Washington and the adjoining states is a significant consideration in any water planning for the Columbia River Basin. The Columbia Basin Tribal Groups and Reservations are listed in Table 3-16.

Table 3-16. Columbia River Basin Tribal Groups and Reservations

Burns Paiute Tribe (Oregon)	3,000 members; 770 acres of trust land acquired in 1935 to reestablish reservation; 11,000 acres of allotment land owned by tribal members
Coeur d'Alene Tribe (Idaho)	1,700 members; 345,000-acre reservation; rights based on treaties as early as 1873
Confederated Salish and Kootenai Tribes of the Flathead Reservation (Montana)	6,900 members; 1.3 million-acre reservation; assert rights based on 1855 Treaty of Hellgate
Confederated Tribes of the Colville Reservation (Washington)	9,500 enrolled members; 1.4 million-acre reservation; rights based on 1872 Executive Order and other agreements with U.S. (1892, 1905)[1]
Confederated Tribes of the Umatilla Indian Reservation (Oregon)	2,174 enrolled members; 180,441-acre reservation; rights based on 1855 Treaty
Confederated Tribes of the Warm Springs Indian Reservation (Oregon)	3,916 enrolled members; 650,000-acre reservation; rights based on 1855 Treaty and federal court cases
Kalispel Tribe of Indians (Washington)	280 enrolled members; 4600-acre reservation; rights based on 1914 Executive Order
Kootenai Tribe (Idaho)	67 members as of 1974; tribal members accepted 12.5 acres but do not consider it to be a final settlement
Nez Perce Tribe (Idaho)	3,200 members; 770,453-acre reservation; rights based on treaties of 1855 and 1863, and federal court decisions
Shoshone-Bannock Tribes of the Fort Hall Reservation (Idaho)	4,291 members; 544,000-acre reservation; rights based on 1867 Executive Order
Shoshone-Paiute Tribes of the Duck Valley Reservation (Nevada)	1,818 members; 289,820-acre reservation; rights based on 1863 Treaty, 1877 Executive Order, and other statutory additions to reservation
Spokane Tribe of Indians (Washington)	2,441 members, 100,000 acres held in trust; 57,370 additional acres held as allotments, deeded fee land, other government lands; rights based on 1880 Executive Order
Confederated Tribes and Bands of the Yakama Nation (Washington)	9,092 members; 1.39 million-acre reservation; rights based on 1855 Treaty

Source: National Research Council 2004. Updated as to membership in the Confederated Tribes of the Colville Reservation.

1 The Colville Tribes also hold fishing and water rights on 1.5 million acres referred to as the North Half pursuant to an agreement with the United States, which was executed in 1891 and ratified by Congress in 1906-1910.

3.6.1.4 Hanford Reach National Monument

Non-Indian federal land can also benefit from federal reserved water rights. In 2000, President Clinton signed an Executive Order creating the Hanford Reach National Monument, a 195,000-acre monument along the Columbia in south-central Washington (Proclamation 7319, Establishment of the Hanford Reach National Monument, June 9, 2000). The site includes a 51-mile stretch of the Columbia River upstream of Richland. The proclamation recognizes the importance of this reach of the river for fishery values. The "Reach supports some of the most productive spawning areas in the Northwest, where approximately 80 percent of the upper Columbia Basin's fall Chinook salmon spawn. It also supports healthy runs of naturally spawning sturgeon and other highly-valued fish species" (National Research Council 2004).

The Hanford Reach National Monument withdrawal creates a non-Indian federal reserved water right with a priority date of June 9, 2000. Among the purposes of the withdrawal is the reservation of water necessary to support spawning salmon and other fish species. This reserved right will prevent any new, upstream consumptive diversions that would leave insufficient flows in the river to maintain the fishery protected by the reservation. As such, this reservation could be a significant constraint on new diversions upstream of the Hanford Reach (National Research Council 2004).

3.6.1.5 International-Interstate Issues

Management of the Columbia River must account for water rights of upstream water users and their demands on the river. These include the province of British Columbia and the states of Montana, Idaho, and Oregon. Ecology has recognized these factors in administrative rules regarding the Columbia and Snake Rivers:

> The Columbia River is an international as well as an interstate river with its waters subject to laws of seven western states, the Province of British Columbia, Canada, and the federal governments of the United States and Canada. The flows and levels of the river are in a state of continuous change through the operation of numerous federally owned or federally licensed dams located within the River. The waters of the Columbia River are operated to support extensive irrigation development, inland navigation, municipal and industrial uses, and hydroelectric power development. Among all these uses, the anadromous fisheries of the Columbia River, which are dependent on clean flowing water, require for their survival the establishment of minimum flows of water and special actions by all agencies sharing in the management of the Columbia River (WAC 173-563-010).
>
> The Snake River is an interstate river with waters subject to laws of five states and the federal government. The flows and levels of the river in Washington are heavily influenced by the operation of federally owned and federally licensed dams located upstream from Washington and within Washington as well as by water diversions in the various states (WAC 173-564-010).

Water management depends heavily on the certainty of information regarding water rights, which in turn depends in large part on whether the rights have been adjudicated. A water rights adjudication is a quiet title action to determine the extent and validity of existing water rights. The states that share the Snake and Columbia Rivers are in various stages of adjudicating their water rights.

Montana has required permits for surface water diversions and ground water withdrawals since 1973 and is in the process of adjudicating pre-1973 water rights statewide. The process is slow and the claims of the Salish and Kootenai Tribes of Flathead Indian Reservation have not been resolved. There is considerable uncertainty regarding the water rights in Montana (National Research Council 2004).

The Snake River Basin Adjudication in Idaho, which covers approximately 87 percent of the state, is nearing completion (Evans 2004). In 2006, the Idaho Legislature passed a bill that "authorizes the adjudication of all rights to the use of water from surface water and ground water sources whether or not hydraulically connected within the Coeur D'Alene-Spokane River Basin, the Palouse River Basin, and the Kootenay and Clark Fork-Pend Oreille River Basins. RS 15705, Statement of Purpose/Fiscal Impact." One state senator gave as a reason for voting for the bill that "the state of Washington is laying claim against North Idaho's water, and the adjudication will help Idaho defend its water" (Russell 2006).

Oregon is adjudicating all pre-1909 surface water rights and all pre-1955 ground water rights. As of 2004, the state had conducted 94 adjudications covering 70 percent of the state. Even the rights of the Warm Springs Reservation have been determined, but the Tribe has been assigned all water in excess of the 1996 non-Indian uses (National Research Council 2004).

Given the incomplete adjudication of water rights in the states with interests in the Columbia and Snake Rivers, there is substantial uncertainty regarding water rights outside of Washington and claims that maybe made to water flowing downstream through the state.

There are three international treaties that define the water rights relationship between Canada and the state of Washington. The Columbia River Treaty was signed in 1961 and ratified in 1964. The Treaty provided for the construction of four upper Columbia River storage dams—three in Canada and one in Montana. The dams provide flood control and increased hydropower generation. Under the Treaty, Canada has rights to divert up to 1.5 million acre-feet per year from the Kootenay River into the headwaters of the Columbia River. Either Canada or the United States can terminate the Treaty in 2024 with 10 years advance notice. If the Treaty is terminated, Canada has the right for 40 years thereafter to divert an unspecified quantity of water from the Kootenay River into the Columbia as long as the flow of the Kootenay at the border is 2,500 cubic feet per second (cfs) or the natural flow. Canada pledged in the Treaty not to divert water in such a way that the flow crossing the boundary is altered. This agreement is designed to prevent Canada from diverting water into the Fraser River, which Canada had proposed prior to the Treaty (National Research Council 2004).

The Boundary Waters Treaty ratified in 1909 created the bilateral International Joint Commission (IJC) to address water rights disputes between Canada and the United States. Under the terms of the Treaty, if additional Columbia River water was to be diverted by Canada, a downstream water user in Washington could contest that diversion the same as a Canadian citizen. However, the principles of jurisdiction and control over water in the Treaty are somewhat contradictory, and any protest would have to work its way through the IJC, which is a slow process. "Canada likely has an unquantified but, for purposes of prior appropriation in Washington, a senior claim based [upon] its equitable interest in the river. Additional U.S. water diversions in the Columbia River may remain subject to additional Canadian development, the latter of which would be entitled to priority. This does not consider any water-related claims of indigenous people north of the forty-ninth parallel" (National Research Council 2004).

The Pacific Salmon Treaty does not impose any specific quantity obligations upon the United States. However, both countries have agreed to "maintain adequate water quality and quantity" to sustain salmon fisheries (National Research Council 2004).

3.6.1.6 ESA-Biological Opinion

Twelve populations of salmon and steelhead in the Columbia Basin are currently listed as endangered or threatened under the Endangered Species Act (ESA). These species are listed and described in Section 3.7.

The ESA listings have major implications for water rights. Section 9 of the ESA prohibits any person from "taking" an endangered species and defines "take" to include "harm" (16 U.S.C. 1532(19)).[6][7] Harm is defined as "an act which actually kills or injures wildlife" and may include significant habitat modification or degradation where it actually kills or injures wildlife (50 CFR Sect. 17.3). Individual water rights may cause harm when the appropriation results in or contributes to the "lack of sufficient stream flow to sustain healthy fish populations" (Pharris and McDonald 2000), as evidenced by death or injury to individuals of the listed species. Existing water rights are not likely to be an adequate defense to a take action. "ESA can potentially upset the 'natural' order by requiring that water rights, regardless of their priority date, may be restricted in order to protect listed species" (Pharris and McDonald 2000).

The ESA imposes a substantive duty on all federal agencies to "insure that any action authorized, funded, or carried out" by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or result in destructive or adverse modification of designated critical habitat (16 U.S.C. 1536(a)(2)). The 2000 and 2004 Biological Opinions issued by NOAA Fisheries regarding the operation of the Federal Columbia River Power System (FCRPS) include flows identified as reasonable and prudent alternatives to avoid jeopardy to listed fish species in the Columbia Basin. The 2000 Biological Opinion was remanded to NOAA, and the agency subsequently issued the 2004 Biological Opinion, which was also appealed. In October 2005, Judge James Redden of the U.S. District Court in Oregon remanded the 2004 Biological Opinion to NOAA to make a jeopardy determination for operation of the FCRPS that complies with ESA requirements. The Order directs that the 2004 Biological Opinion shall remain in place during the remand (*Opinion and Order on Remand*, CV 01-640-RE (Lead Case), CV 05-23-RE (Consolidated Cases) (October 7, 2005)).

[6] Regulations of the USFWS extend the prohibition on "take" to threatened species (Pharris and McDonald 2000).

[7] "Person" is defined broadly to include an individual, a corporation, a state, a municipality or any other entity subject to the jurisdiction of the U.S. (16 U.S.C. 1532(13)).

Any decisions for management of the Columbia River Basin water resources must take into account the flows set in the 2004 Biological Opinion and ensure that there is no impact on the flows that could result in the taking of a listed salmonid species.

3.7 Fish, Wildlife, and Plants

3.7.1 Fish

The aquatic communities and life history forms in the Columbia River Basin are quite diverse (Appendix H). Assorted species inhabit an equally diverse variety of habitat types ranging from freshwater mountain springs to marine waters. The variety of vertebrate (fish, amphibian, and reptile) and invertebrate (mollusk and arthropod) life in the basin prohibits an exhaustive listing of species and habitats.

This section describes the animals in each of the aquatic categories from the Washington Department of Fish and Wildlife's (WDFW) Priority Habitats and Species (PHS) program. Aquatic species that are listed as state-priority species, state-listed under Washington statue (WAC 232-12-297), or listed under the federal Endangered Species Act (ESA) are itemized below in Sections 3.7.1.1 through 3.7.1.3. These sections also present a brief life-history description, status, and habitat conditions for each of the key fish populations in the basin and any other species identified during EIS scoping. Section 3.7.1.4 describes habitat conditions in the vicinity of the proposed early actions.

3.7.1.1 Federally Listed Species

Fish species listed by the federal government as either threatened or endangered in the Columbia River Basin within Washington are listed in Table 3-17. Under the ESA, an "endangered" species is "any species which is in danger of extinction throughout all or a significant portion of its range." A threatened species is "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Candidate species are under consideration for listing as an endangered or a threatened species, but not yet the subject of a proposed rule (see 50 CFR 424.02). The federal government identifies species of concern as species about which they have some concern regarding status and threats to these species, but for which insufficient information is available to indicate a need to list the species under the ESA.

Table 3-17. Federally listed fish species under the ESA in the Columbia River Basin.

Region (ESU / DPS)*	Species	Listing Status
Upper Columbia River	spring Chinook salmon (*Oncorhynchus tshawytscha*)	Endangered
	steelhead trout (*O. mykiss*)	Threatened
Mid-Columbia River	steelhead trout (*O. mykiss*)	Threatened
Snake River	sockeye salmon (*O. nerka*)	Endangered
	fall Chinook salmon (*O. tshawytscha*)	Threatened

Region (ESU / DPS)*	Species	Listing Status
	Spring/summer Chinook salmon (*O. tshawytscha*)	Threatened
	steelhead trout (*O. mykiss*)	Threatened
Lower Columbia River	Chinook salmon (*O. tshawytscha*)	Threatened
	coho salmon (*O. kisutch*)	Threatened
	steelhead trout (*O. mykiss*)	Threatened
Columbia River Basin	chum salmon (*O. keta*)	Threatened
	bull trout (*Salvelinus confluentus*)	Threatened
	eulachon (*Thaleichthys pacificus*)	Candidate
	Pacific lamprey (*Lampetra tridentatus*)	Species of Concern
	river lamprey (*L. ayresi*)	Species of Concern
	western brook lamprey (L. richardsoni)	Species of Concern
	coastal cutthroat trout (*O. clarki clarki*)	Species of Concern
	westslope cutthroat trout (*O. clarki lewisi*)	Species of Concern
	Redband trout, an interior race of rainbow trout (*O. mykiss*)	Species of Concern
	pygmy whitefish (*Prosopium coulteri*)	Species of Concern
	margined sculpin (*Cottus marginatus*)	Species of Concern
	Great Columbia River spire snail (Columbia Pebblesnail; *Fluminicola columbianus (=fuscus))*	Species of Concern
	California floater (*Anodonta californiensis*)	Species of Concern

*DPS = distinct population segment; ESU = evolutionarily significant unit

3.7.1.2 Washington State-Listed Species

The state of Washington lists species in accordance with its endangered, threatened, and sensitive wildlife species classification (WAC 232-12-297) (WDFW 2006). A state designation of "endangered" means any species native to Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state. "Threatened" means any species native to Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats. "Sensitive" means any wildlife species native to Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

State candidate species include fish and wildlife species that WDFW will review for possible listing as state endangered, threatened, or sensitive. A species will be considered for designation as a state candidate if sufficient evidence suggests that its status may meet the listing criteria defined for state endangered, threatened, or sensitive (WDFW Policy M-6001).

Most of the fish species currently on the state list are also included under the federal ESA list. However, the following four species only occur as state candidate species: lake chub (*Couesius plumbeus*), leopard and Umatilla dace (*Rhinichthys falcatus* and *R. umatilla*), and mountain sucker (*Catostomus platyrhynchus*).

3.7.1.3 State Priority Habitat and Species (PHS) Program

WDFW maintains a PHS program to provide information on important fish, wildlife, and habitat resources in the state. The program maps known locations of priority habitats and species and provides information on the conditions required to maintain healthy populations of priority species and viable, functioning priority habitats. Aquatic animals listed as state-priority species are described below in major aquatic categories, with an example of species present in the Columbia River system included in parentheses for each category.

Invertebrate

There are a few priority species of arthropods (e.g., insects, crustaceans and mollusks such as snails, freshwater clams, and mussels) or echinoderms (urchins) in the project area. Insects within the project area include the Columbia River tiger beetle (*Cicindela columbica*), a species of concern and candidate species in Washington.

Mollusks include the priority species of gastropods (giant Columbia River limpet, *Fisherola nuttalli*, and great Columbia River spire snail, *Fluminicola columbiana*), and the freshwater mussel (California floater, *Anodonta californiensis*). All three of these mollusk species are state candidate species. The great Columbia River spire snail (Columbia pebblesnail, *Fluminicola columbianus =fuscus*) and the California floater are also federal species of concern, as mentioned in Table 3-17.

Vertebrate

Fish in the project area include the priority species categories of lamprey (Pacific lamprey); sturgeon (white sturgeon); minnows (lake chub); suckers (mountain sucker); catfish (channel catfish); smelt (eulachon); trout, salmon, and whitefish (bull trout); sculpins (margined sculpin); sunfish (largemouth bass); and perches (walleye) (WDFW 2006). This list of fish includes both native and non-native as well as freshwater and anadromous species.

Key Fish Population Status and Habitat Conditions

Fish habitat and recovery efforts for ESA-listed species, especially for fish in the salmon family (salmonidae), are critical components of large-scale water resource management efforts and will be addressed in more detail below. For purposes of this document, the term “salmonid” applies to trout, char, and salmon consistent with the Governor’s *Statewide Strategy to Recover Salmon*

– *Extinction is not an Option* (WSJNRC 1999). The following discussion is segregated into salmonid fishes and non-salmonid fishes.

Resident Salmonid Fishes

Resident salmonids remain in freshwater habitat for their entire life cycle. All resident salmonids require clean, cool water to thrive. Some populations of resident salmonid fishes in Washington are declining. Such declines can be attributed to a number of factors, including loss of suitable rearing habitat, water quality degradation, and loss of clean spawning gravels.

Resident salmonids typically feed on plankton, insects, other invertebrates, and small fish. Some of the most important and widespread native species of resident salmonids are rainbow trout (including redband trout), cutthroat trout, bull trout, and mountain whitefish. These species are discussed below in more detail.

There are a number of introduced (non-native) resident salmonid species in Columbia River Basin lakes and streams, including brown trout, golden trout, lake trout, and eastern brook trout. No additional discussion of these species is included in this EIS.

Rainbow Trout. Rainbow trout are widely distributed in the Columbia River Basin and are the state's most popular game fish. Because of their popularity, natural populations are supplemented by WDFW stocking programs that add over 17 million rainbow trout each year to the state's lakes and streams. Resident rainbow trout generally grow to a length of 18 to 24 inches. Rainbow trout include the subspecies of concern known as the red-band trout that is native to Washington in the Columbia River Basin.

Cutthroat Trout. Resident coastal cutthroat trout are found in streams and ponds throughout much of the lower Columbia River Basin, whereas westslope cutthroat trout, another cutthroat subspecies, are common throughout the middle and upper Columbia and Snake River Basins in eastern Washington lakes and streams. Although cutthroat trout may grow to a length of about 18 inches, in small bodies of water they may grow no larger than 8 or 9 inches. Cutthroat trout are planted by the WDFW in a number of high-country lakes. Native populations of westslope cutthroat trout also exist in eastern Washington lakes and streams.

Bull Trout. Although commonly called trout, bull trout are members of the char subgroup of the salmon family. Bull trout living in streams may grow to about 4 pounds, while those living in lakes reach a weight of up to 20 pounds. Resident life-history forms of bull trout live their full life cycle in areas near where they were hatched, while other forms migrate from streams to lakes, reservoirs, or saltwater bodies a few weeks after emerging from their nests. While bull trout are known to live as long as 12 years, they reach sexual maturity between 4 and 7 years of age. They spawn in gentle stream reaches with cold, clean water and gravel amid cobble substrate. Spawning occurs in the fall after stream temperatures have dropped to a satisfactory level. Bull trout prefer water temperatures cooler than most other salmonid species, which makes them susceptible to warming temperature trends in the region. Ecology has altered the state's surface water quality standards (Chapter 173-201A WAC) designating specific waters of the state as native char habitat for purposes of applying a protective temperature water quality criterion (Ecology 2003a).

Dolly Varden. As with bull trout, Dolly Varden are members of the char subgroup of the salmon family (Salmonidae). Dolly Varden are common in many rivers and some lakes, especially in coastal areas of Washington. The Dolly Varden is similar in appearance to bull trout but is generally smaller. Dolly Varden populations have generally been declining, and fishing for Dolly Varden has been restricted in a number of areas by the WDFW. This species is often treated in concert with bull trout as native char under the similarity of appearances rule in the ESA.

Mountain Whitefish. Mountain whitefish are in a separate subfamily of salmonidae (Coregoninae) and may be the most numerous salmonid in Washington. They are resident in large- and medium-sized rivers, where they inhabit deep pools with strong current. They feed mainly on bottom organisms, including midge, mayfly, stonefly, and caddisfly larvae.

Anadromous Salmonid Fishes

Fish that spawn and rear in fresh water, spend a portion of their life in salt water, and then return to fresh water to begin the life cycle again are referred to as anadromous species. The Columbia River Basin has eight native species of anadromous salmonid fishes, including Chinook, coho, chum, and sockeye salmon; steelhead and sea-run coastal cutthroat trout; and native char (bull trout and Dolly Varden).

Salmon habitat extends from the smallest inland streams to the Pacific Ocean and consists of a vast network of freshwater, estuarine, and ocean habitats. Freshwater habitats are used for spawning, incubation, and juvenile rearing. In estuarine habitats, juvenile salmonid fish experience rapid growth and chemical changes as they transition between fresh water and salt water. Salmon gain most of their adult body mass in ocean habitats before returning to rivers to spawn (WDFW 2000-2001).

Salmon feed on a variety of freshwater and marine invertebrate organisms and fishes, while being fed upon by a variety of parasites, predators, and scavengers. Juvenile salmon feed on salmon carcasses, eggs, and invertebrates, including invertebrates that may have previously fed on salmon carcasses such as caddisflies, stoneflies, and midges. Thus, returning salmon provide a flow of nutrients into freshwater habitats and play a critical role in the ability of watersheds to retain overall productivity of salmon runs (WDFW 2000-2001).

Due to over-fishing, habitat loss, the effects of hydropower facilities, hatchery problems, and a changing ocean environment, salmonid fish populations have declined substantially over the past several decades. The biology of the major anadromous fish species in the Columbia River Basin is summarized below.

Chinook Salmon. Chinook salmon are the largest of all salmon. There are different seasonal “runs” or modes in the migration of Chinook salmon from the ocean to fresh water. These runs are usually identified as spring, summer, or fall, based on when the adult salmon enter fresh water to begin their spawning migration. Chinook prepare spawning beds in flowing streams with suitable gravel composition, water depth, and velocity. Juvenile Chinook may spend from three months to two years in fresh water before migrating to estuarine waters as smolts. After a period of rapid growth and physiological change to adapt to salt water in the estuaries, they migrate to the ocean, feed, and mature. Chinook remain in the ocean for one to six years, but most commonly between two and four years.

Although a variety of juvenile life-history expressions exist within Chinook, differences in the seasonal timing of the runs generate differences with respect to the length of juvenile maturation and freshwater residence. Adult spring Chinook enter the rivers first and spawn in the high-elevation tributaries in the watersheds. Summer Chinook enter later and spawn in the mid-elevation tributaries and rivers, whereas fall Chinook enter last and are primarily low-elevation, mainstem river spawners. Based on water temperatures during incubation and juvenile rearing, most of the summer and fall Chinook juveniles mature quickly and outmigrate as young-of-the-year subyearling fish (0+ age smolts; ocean-type maturation) (Myers et al. 1998). Conversely, spring Chinook mature slowly, hold overwinter and generally migrate as yearling fish (1+ age smolts; stream-type maturation). Each of the stocks varies with respect to the proportion of subyearling and yearling outmigrants (Myers et al. 1998).

Coho Salmon. Coho salmon spend approximately half their life cycle rearing in freshwater streams and tributaries. The long freshwater rearing period makes coho salmon more dependent on flow and freshwater habitat conditions than species with short freshwater rearing times. The remainder of their life cycle up to the point of returning to their stream of origin to spawn is spent foraging in estuarine and marine waters of the Pacific Ocean. Most adults return as three-year-olds; however, a small number return after two years. A mature coho is usually about 2 feet in length and weighs an average of about 8 pounds. Existing runs of native coho salmon are limited to areas downstream of Bonneville Dam.

Chum Salmon. Chum are large salmon, second only to Chinook salmon in size. They spawn in the lower reaches of rivers and streams, typically within 60 miles of the Pacific Ocean. They outmigrate almost immediately to estuarine and ocean habitats after hatching. Thus, survival and growth of juvenile chum depends less on freshwater habitat conditions than on estuarine and marine habitat conditions. They usually arrive at their stream of origin from November to the end of December. Most chum salmon mature from three to five years. The weight of a mature chum salmon is 18 to 22 pounds. The species is not distributed upstream of Bonneville Dam.

Sockeye Salmon. Sockeye salmon exhibit a variety of life history patterns that reflect varying dependency on freshwater environments. Most sockeye salmon spawn in or near lakes where juveniles rear for one to three years before migrating to the ocean. For this reason, the major distribution and abundance of this salmon species is closely related to the location of rivers that have accessible lakes in their watersheds, such as the Wenatchee River (Lake Wenatchee), Okanogan River (Osoyoos Lake), and Snake River (Redfish Lake).

There are also non-anadromous forms of sockeye salmon (kokanee) that spend their entire life in fresh water. Occasionally, a portion of the juveniles in an anadromous population will remain in their rearing lake environment throughout their lives and will eventually spawn with their anadromous siblings.

Steelhead Trout. Steelhead are seagoing rainbow trout. They begin their lives in freshwater rivers and streams, where they rear for approximately two years before migrating to marine waters. Consequently, they are dependent on flows and freshwater habitat. Steelhead reside in marine waters for one to six years (typically two to three years), then return to their home streams to spawn. Unlike salmon, which die after spawning, adult steelhead can return to the sea and repeat the cycle. Adult steelhead typically range from 5 to 14 pounds, although those with long ocean residence time may reach about 30 pounds.

Two distinct runs of steelhead return to fresh water at different times—winter run and summer run. However, steelhead from both runs mostly spawn from mid-winter to late spring. Wild steelhead runs have been depleted in a number of river systems in the Columbia River Basin because of habitat loss (WDFW 2001).

Sea-Run Cutthroat Trout. Sea-run cutthroat trout are the anadromous population of the coastal cutthroat trout. Like steelhead, sea-run cutthroat trout rear for two years in fresh water before migrating and thus are dependent on stream flows and freshwater habitat conditions. They spawn in lower Columbia River tributary streams. None of the coastal cutthroat trout evolutionarily significant units (ESUs) have been found to warrant listing under the federal ESA.

Bull Trout. As previously discussed, some portions of bull trout populations exhibit anadromous life history patterns. The ocean residence period of bull trout populations is typically short, with fish returning to fresh water within a year.

Non-salmonid Fishes

The discussion of non-salmonid fishes is separated into freshwater resident fish and anadromous fish species. Some of the fish described below live at least a portion of their lives in estuaries or tidal portions of rivers that are transitional between fresh water and marine waters.

Freshwater Resident Species. Approximately 70 non-salmonid fish species can be found in freshwater bodies of the Columbia River system at some point in their life cycles. Of this number, over 30 species are introduced, including some of the more popular sport fish such as largemouth bass, smallmouth bass, walleye, crappie, yellow perch, catfish, tiger muskie, and bluegill sunfish. Native freshwater species include sturgeon, the largest freshwater fish species; a variety of minnows such as northern pikeminnow, redside shiner, leopard dace, and speckled dace; burbot (a member of the cod family); largescale sucker; sandroller; western brook lamprey; and a number of sculpin species (WDFW 1997; WDFW 2001).

Anadromous Fish Species. Native and non-native species, such as white sturgeon, Pacific and river lamprey, Columbia River smelt (eulachon), and American shad are anadromous species using portions of the Columbia River Basin. Although an anadromous species, white sturgeon have been isolated in portions of the Columbia River system due to dam construction and the lack of fish passage facilities. Given their long life span that can exceed 100 years, many sturgeon remain in reservoirs and tributary waters after dam construction. For example, a large population still exists in Lake Roosevelt, which was inundated in 1948. It is unknown if this population can access tributary areas in the reservoir for flowing water that is required for successful spawning and juvenile development. Without viable spawning areas, the existing sturgeon populations are at risk of ageing and becoming extinct.

In 2000, a collaborative effort of U.S. and Canadian government agencies, tribes, industry and organizations developed a joint recovery plan for the "Upper Columbia White Sturgeon

Recovery Initiative (UCWSRI)." Efforts to reverse the decline of sturgeon in Lake Roosevelt included the first ever release of hatchery-reared white sturgeon in the spring of 2004.

American shad have benefited from hydropower development in the Columbia River Basin, which has increased both their numbers and distribution in the system. The Columbia River offers the largest annual shad migration in the world.

The lamprey species are considered in a state of decline. Much work is currently being expended to improve fish passage facilities to accommodate the lamprey species in the basin. Abundance levels of Pacific lamprey in the upper Columbia River basin are very low, with only 35 and 21 fish passing Lower Granite and Wells Dams, respectively, in 2006 (Spokane Tribe, personal communication, 2006). The peak mainstem migration for lamprey occurs in June and early July and spawning occurs during the spring.

Native Shellfish

Shellfish (mollusks) such as the giant Columbia River limpet (shortface lanx), the great Columbia River spire snail (Columbia pebblesnail, *Fluminicola columbianus (=fuscus)*), and the California floater were once common throughout the Columbia River Basin. All three species require cold, clear water habitats. The shortface lanx prefers high-velocity portions of the system, whereas the California floater prefers lower-gradient areas with soft, silty substrate.

Human alteration of the Columbia River system has limited the distribution and abundance of all three of these native shellfish species. Currently, all three mollusk species are state candidate species.

Species of Concern Identified during Scoping

During May 2006, scoping for the Management Program EIS took place during open house meetings in four cities in the project area. The public, tribal, and agency input generated during these meetings did not identify aquatic species of concern to address in the assessment of environmental effects, other than the ones discussed in the previous sections. The sole exception was the survival of juvenile carp (*Cyprinus carpio*) in the Kettle River area due to the proposed Lake Roosevelt drawdown.

A review of the biological characteristics of carp suggests the early life history stages are vulnerable to lake level fluctuations following spawning. Nevertheless, carp are an extremely successful species that can tolerate a wide range of environmental conditions and endure relatively poor habitat conditions. Carp have a relative high level of fecundity, with reports of as many as 360,000 to 1,000,000 eggs per female (Aguirre and Poss 2000). "High fecundity, fast growth rate, wide physiological tolerance, and omnivorous diet result in carp having the ability to spread into nearly any aquatic habitat" (Parkos and Wahl 2000).

Carp are an introduced species and are regarded as an invasive fish species that reportedly has adversely affected native fish communities and habitat conditions. Efforts to eradicate carp populations have been largely unsuccessful because they are able to quickly recolonize open systems. Once established in a water body, common carp are difficult to eliminate. As a result of these biological characteristics, further assessment of carp in this document is judged not to be warranted.

3.7.1.4 Early Action Study Areas

Early action study areas include the regions around Lake Roosevelt, as a function of storage and drawdown for potential water right permits; Supplemental Feed Routes from Billy Clapp Lake to the Potholes Reservoir; and the CSRIA Voluntary Regional Agreement (VRA). The local fishery resource in each of these areas is described below.

Lake Roosevelt

Lake Roosevelt currently supports 32 species of fish (20 game and 12 non-game species). Rainbow trout, kokanee (landlocked sockeye) salmon, and walleye are the three primary fish harvested in the reservoir, with smallmouth bass increasing in popularity over the past five years. White sturgeon and bull trout fishing are currently closed, and lesser fisheries exist for other species such as smallmouth bass, largemouth bass, yellow perch, lake whitefish, mountain whitefish, brown trout, brook trout, burbot, cutthroat trout, black crappie, pumpkinseed, brown bullhead, yellow bullhead, and channel catfish. Non-game fish in Lake Roosevelt, native to the upper Columbia River, include northern pikeminnow, largescale sucker, longnose sucker, bridgelip sucker, redside shiner, longnose dace, chiselmouth, peamouth, speckled dace, sculpin species, and non-native species including carp and tench.

Three major fish tournaments are held annually on Lake Roosevelt: Two Rivers Casino Trout Derby, Governor's Cup Walleye Tournament, and Washington State Qualifiers Series for smallmouth bass. The popular fishery at Lake Roosevelt brings in an estimated $5.3 million to $20.7 million annually to the economy (McLellan et al. 2003).

The Confederated Tribes of the Colville Reservation and the Spokane Tribe have interests in the resident fishery of Lake Roosevelt. Both have committed substantial resources to build and protect the resident lake fishery. The Confederated Tribes of the Colville Reservation are currently performing additional resident fish studies in Lake Roosevelt. Information from these efforts will be incorporated into the Supplemental EIS on Lake Roosevelt drawdowns.

Supplemental Feed Route

Banks Lake and Billy Clapp Lake are common to all of the Supplemental Feed Routes. Fishery resources for both lakes are described below.

Since its creation in the early 1950s, Banks Lake has been operated and maintained for the storage and delivery of irrigation water drawn from the Columbia River at Grand Coulee Dam. The Bureau of Reclamation operates the reservoir within established constraints on water surface elevation to meet contractual obligations, ensure public safety, and protect public property. Water is pumped nearly 280 feet in elevation from Lake Roosevelt and stored in Banks Lake. Banks Lake is 27 miles long and it supports a variety of non-game, warmwater and cold water game fish species, most notably walleye, bass, trout and kokanee (land-locked sockeye salmon) as the primary game fish species. Kokanee provide a valuable, year-round sport fishery. Kokanee naturally spawn in the lake during October and November, with peak spawning around the first week of November. Banks Lake is operated favorably with respect to the kokanee life cycle, and the lake supports a population sufficient to maintain a substantial recreational fishery. The WDFW supplements the kokanee population with annual fry plants from the Ford Hatchery.

Billy Clapp Lake, a 1,000-acre reservoir, steadily produces a good fishery for one- to two-pound rainbow trout. Some 15- to 16-inch kokanee are also present, along with a few walleye. The steep shoreline provides very little foot access, so most fishing occurs by boat. The fishing season is open year-round.

Three feed route alternatives have been proposed to transfer water from Billy Clapp Lake to the Potholes Reservoir. Of the three alternative routes, only the upper Crab Creek route from Brook Lake through Moses Lake and on to Potholes Reservoir supports viable production of fish.

Drawdown of Billy Clapp Lake on the order of 20 feet between January and March to accommodate supplemental feed volumes (Blanchard 2006) could have an adverse influence on rainbow trout, kokanee, and walleye fisheries in the lake. However, the drawdown is early enough in the season to minimize the influence on most game fish and forage fish spawning activities. Most of the fish species will be spawning during the refilling period when lake level elevations will be increasing approximately 2 feet per day.

Moses Lake is a 6,800-acre lake that is among the best walleye fisheries in the state, especially in April and May. Large yellow perch have also been abundant. A volunteer cooperative net-pen project has greatly improved angling for rainbow trout, many in the 2- to 3-pound range. Smallmouth bass are plentiful, with some largemouth bass also available. Moses Lake has a very large, underutilized population of 2- to 3-pound lake whitefish. Crappie and bluegill fishing also occurs. Intensive biological surveys are underway to learn more about the decline of the panfish fishery here, and to develop possible management improvements.

Crab Creek Route Alternative

Crab Creek upstream of Brook Lake maintains late summer stream flow, but the portion considered for use as a feed route alternative downstream of the lake is ephemeral. Reclamation is currently conducting flow testing to determine how much surface water in this reach is lost to ground water, and if the streambed can efficiently be used for an expanded feed route. If this alternative is proven feasible, additional water in the Crab Creek mainstem during the irrigation season could offer improved habitat conditions for aquatic species during the low flow season.

The ephemeral nature of Crab Creek historically excluded anadromous fish species access to the upper reaches. At present, rainbow, brook, and brown trout have been collected from drainages in the upper Crab Creek area, as have bridgelip sucker, speckled dace, redside shiner, northern pikeminnow, and sculpin species (EWU 2001).

Various subspecies of cutthroat trout were historically planted in the upper Crab Creek drainage. Currently, cutthroat trout are thought to be extirpated from Crab Creek (Behnke 1992; Quinn et al. 2001). However, the possibility remains that tributary streams of Crab Creek may contain remnant cutthroat populations.

Eastern Washington State University (EWU) fish survey data suggest native, interior redband rainbow trout may exist in the Crab Creek drainage along with hatchery origin rainbow trout (EWU 2001). No cutthroat trout were collected during the recent EWU surveys. Crab Creek appears to support populations of native rainbow trout, hatchery rainbow trout, and possibly native cutthroat and/or introduced cutthroat trout, as well as hybrids between the species. Anecdotal evidence suggests that the watershed supports a robust and self-sustaining population of trout, comparable to popular blue ribbon trout streams in the northwestern United States (Kennedy/Jenks et al. 2005).

W20 Canal and Frenchman Hills Wasteway Route Alternatives

No fish species are likely to successfully reproduce and rear in any of the canals proposed for use under the W20 Canal or Frenchman Hills Wasteway Alternatives.

Potholes Reservoir

The 28,000- acre Potholes Reservoir will be the receiving storage reservoir for the additional flows from the Supplemental Feed Route. Game fish species in the reservoir include yellow perch, black crappie, largemouth and smallmouth bass, bluegill, rainbow trout, and walleye. Rainbow trout are stocked annually in the reservoir and the other species are self-sustaining. Fishing occurs year-round.

3.7.2 Plants and Vegetation Communities

The project area occupies several diverse vegetation communities ranging from coniferous forests to shrub-steppe. The major types include mixed conifer forests, shrub-steppe, mixed agriculture and pasture grasslands, and riparian wetlands (Franklin and Dyrness 1973; Cassidy 1997b). Johnson and O'Neil (2001) describe the following habitat types as occurring in the project area:

Forest & woodland habitats

- Westside lowland conifer-hardwood forest
- Westside oak and dry Douglas-fir forest and woodlands
- Montane mixed conifer forest
- Eastside (interior) mixed conifer forest
- Western juniper and mountain mahogany woodlands
- Lodgepole pine forest and woodlands
- Ponderosa pine and eastside white oak forest and woodlands
- Upland aspen forest
- Subalpine parklands

Developed habitats

- Agriculture, pasture and mixed environs
- Urban and mixed environs

Grassland & shrubland habitats

- Alpine grasslands and shrublands
- Westside grasslands
- Ceanothus-manzanita shrublands
- Eastside (interior) canyon shrublands
- Eastside (interior) grasslands
- Shrub-steppe
- Dwarf shrub-steppe
- Desert playa and salt scrub

Aquatic and riparian habitats

- Lakes, rivers, ponds and reservoirs
- Herbaceous wetlands
- Westside riparian wetlands
- Eastside (interior) riparian wetlands
- Mountain coniferous wetlands

Conifer forests dominated by ponderosa pine, Douglas-fir, grand fir, and western larch occur along the east slopes of the Cascade Mountains and the Okanogan Highlands. Ponderosa pine forests are characterized by open, park-like stands of trees with an understory generally devoid of shrubs and dominated by grasses. These forests occupy drier sites characterized by a short growing season and minimal summer precipitation. Other eastern Washington forests vary in species composition and dominance depending on elevation, temperature gradient, and aspect. In the southern Cascades, bands of conifer forest dominated by lodgepole pine are present, characterized by an open canopy and sparse understory of grasses and shrub thickets. In Klickitat and Yakima Counties, small areas of low elevation forests are dominated by Garry oak along with ponderosa pine. These oak woodlands form a mosaic with grasslands, shrub-steppe, or steppe plant communities and support a unique combination of plant species.

The majority of the Management Program project area, including the Columbia Basin and Plateau, is a historic shrub-steppe community dominated by sagebrush and native bunchgrasses (Daubenmiere 1970). Plant communities in this region are strongly shaped by the marked seasonality in precipitation. Rainfall levels range from only 6 inches in the lowest areas to 22 inches in the higher elevations and are concentrated during late autumn and winter (Vander Haegen et al. 2001). Shrub-steppe environments are composed of woody shrubs, grasses, and forbs and typically have a microbiotic crust (an assemblage of soil particles, algae, lichens, and mosses) on the soil surface. WDFW conducted an intensive mapping effort of the remaining shrub-steppe in Washington using satellite thematic mapping methods (Jacobson and Snyder 2000). The mapping study determined that approximately 50 percent of the historic shrub-steppe community has been converted to agricultural crops and grasslands used for livestock grazing or other types of land cover (Daubenmire 1970; Jacobson and Snyder 2000). The land now supports cultivated croplands, orchards, vineyards, and nurseries for over 400 agricultural crops (Vander Haegen et al. 2000). Extensive managed and unmanaged pastures are also present. Wooten suggests that the estimate of remaining shrub-steppe is overly optimistic because much of the remaining shrub-steppe is actually in poor condition or severely degraded (Wooten 2002).

Conservation of remaining shrub-steppe habitat and restoration of disturbed lands are now top priorities for natural resource agencies. Shrub-steppe habitats are difficult to restore due to plant life histories and the slow development of microbiotic crust. Very little shrub-steppe occurs within protected areas, such as national parks or wilderness areas, and the majority is owned publicly for livestock grazing (Knick et al. 2003).

The Conservation Reserve Program (CRP) administered by the U.S. Department of Agriculture (USDA) encourages farmers to voluntarily remove fields from crop production and plant them with grasses. Farmers can enroll in the program for 10 years or more. Over 1 million acres of converted farmlands in Washington, approximately 15 percent of the state's total agricultural lands, have been planted under the CRP (Vander Haegen et al. 2005). Conservation Reserve Program lands provide habitat for many grassland and shrub-steppe species. A study of habitat use by sage-grouse and other shrub-steppe wildlife indicates that the CRP lands are providing valuable increased habitat for several threatened species (Schroeder and Vander Haegen 2006). CRP lands have been documented as providing viable nesting habitat for sage-grouse in north-central Washington and are expected to become more suitable as the sagebrush grows in size and density. Two bird species, grasshopper and Savannah sparrow, which both suffer from long-term population declines, appear to be benefiting from this new habitat (Schroeder and Vander Haegen 2006). Other shrub-steppe associated birds, such as Brewer's and sage sparrow, also benefit from the increased suitable nesting habitat and the new contiguous landscape of CRP land and native shrub-steppe habitats.

Figures 3-12 and 3-13 show the historic and current wildlife habitat types in the project area taken from Johnson and O'Neil (2001). The maps were developed by scientific experts and utilized information from multiple vegetation classification systems, regional mapping efforts by WDFW and Oregon Department of Fish and Wildlife (ODFW), and the Interior Columbia Basin Ecosystem Management Project. The current habitat type map (Figure 3-13) represents vegetation in the project area in 1999, and the historic habitat type map (Figure 3-12) represents a modeled version of vegetation in 1850.

Wetlands in eastern Washington range from riparian areas associated with rivers and streams to potholes in the arid grasslands (Figure 3-13). The channeled scablands of the Columbia River Basin contain scattered alkaline and highly productive wetlands. Lakes, ponds, and marshes are also present in the study area. The National Wetland Inventory (NWI) maps wetlands in the study area associated with rivers, streams, and large systems such as Potholes Reservoir (USFWS various dates).

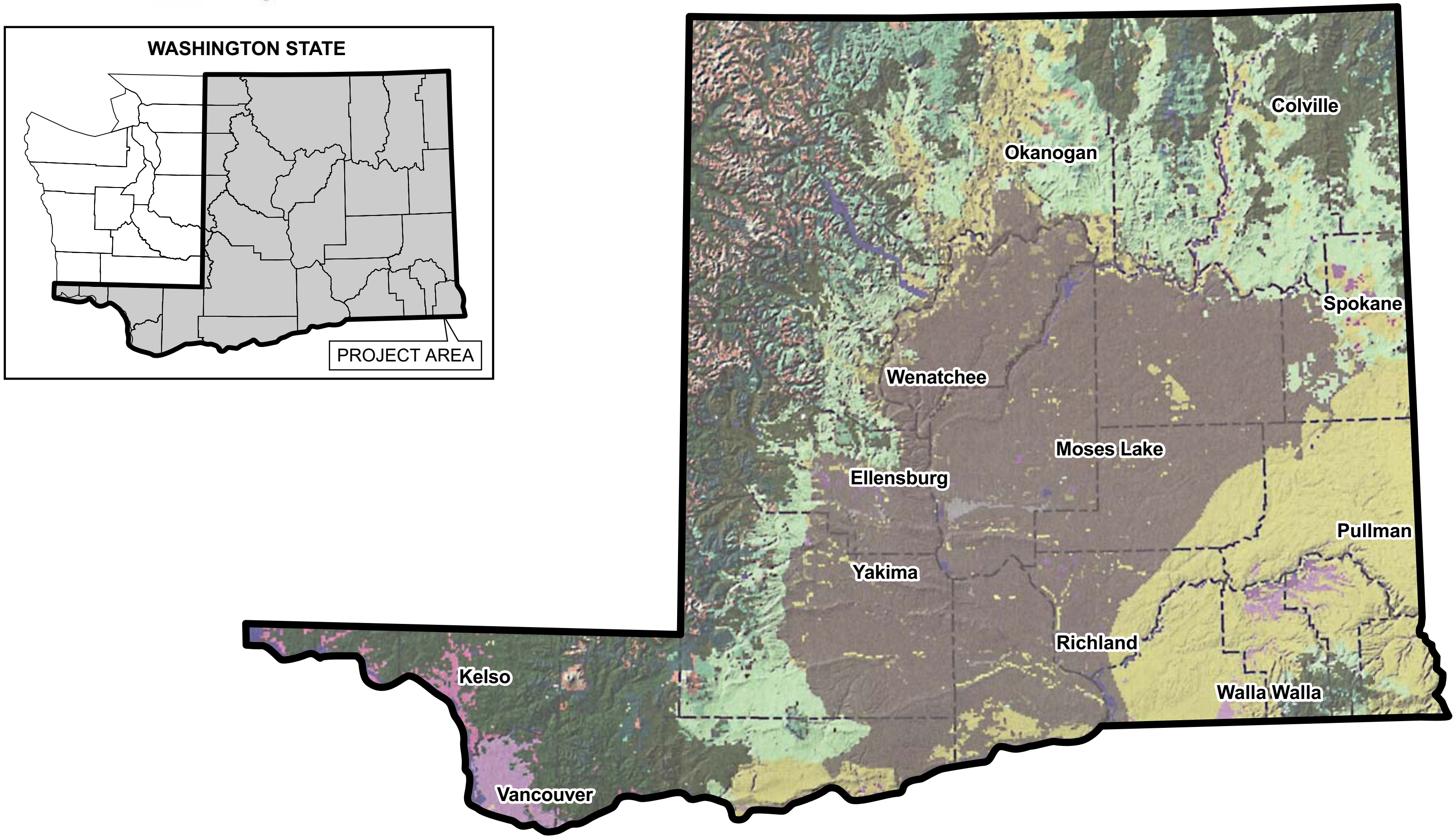
LEGEND

Forest & Woodland Habitats
- Westside Lowland Conifer-Hardwood Forest
- Westside Oak & Dry Douglas-fir Forest & Woodlands
- Montane Mixed Conifer Forest
- Eastside (Interior) Mixed Conifer Forest
- Western Juniper & Mountain Mahogany Woodlands
- Lodgepole Pine Forest & Woodlands
- Ponderosa Pine & Eastside White Oak Forest & Woodlands
- Upland Aspen Forest
- Subalpine Parklands

Grassland & Shrubland Habitats
- Alpine Grasslands & Shrublands
- Westside Grasslands
- Ceanothus-Manzanita Shrublands
- Eastside (Interior) Canyon Shrublands
- Eastside (Interior) Grasslands
- Shrub-steppe
- Dwarf Shrub-steppe
- Desert Playa & Salt Scrub

Developed Habitats
- Agriculture, Pasture & Mixed Environs
- Urban & Mixed Environs

Aquatic & Riparian Habitats
- Lakes, Rivers, Ponds & Reservoirs
- Herbaceous Wetlands
- Westside Riparian - Wetlands
- Montane Coniferous Wetlands
- Eastside (Interior) Riparian - Wetlands



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Map data are the property of the sources listed below.
Inaccuracies may exist, and Adolfson Associates, Inc. implies no warranties or guarantees regarding any aspect of data depiction.
SOURCE: WDFW and Northwest Habitat Institute, 1999.

ADOLFSON

FIGURE 3-12

HISTORIC WILDLIFE HABITAT TYPES

COLUMBIA RIVER WATER MANAGEMENT PROGRAM EIS

WASHINGTON

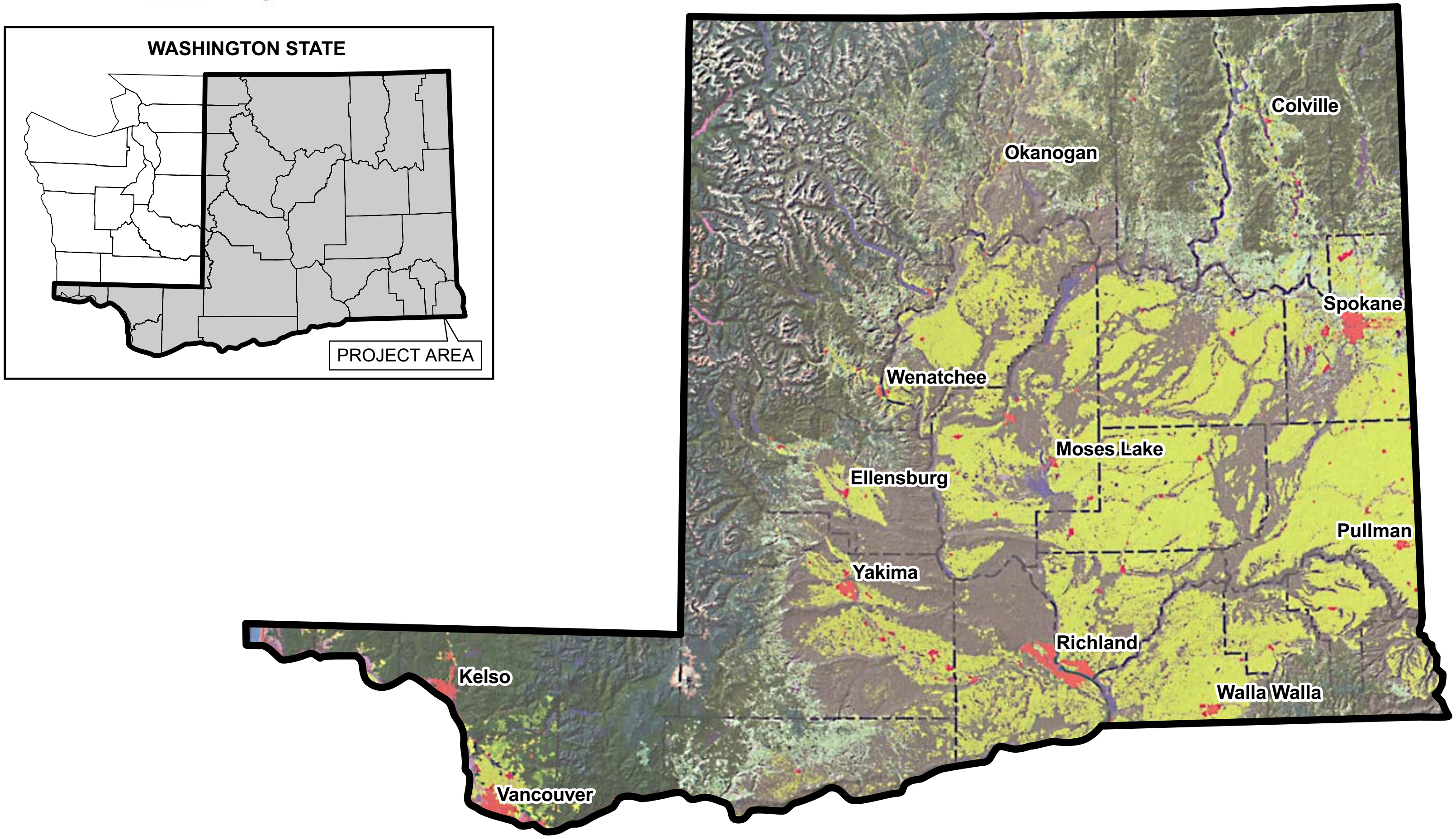
LEGEND

Forest & Woodland Habitats
- Westside Lowland Conifer-Hardwood Forest
- Westside Oak & Dry Douglas-fir Forest & Woodlands
- Montane Mixed Conifer Forest
- Eastside (Interior) Mixed Conifer Forest
- Western Juniper & Mountain Mahogany Woodlands
- Lodgepole Pine Forest & Woodlands
- Ponderosa Pine & Eastside White Oak Forest & Woodlands
- Upland Aspen Forest
- Subalpine Parklands

Grassland & Shrubland Habitats
- Alpine Grasslands & Shrublands
- Westside Grasslands
- Ceanothus-Manzanita Shrublands
- Eastside (Interior) Canyon Shrublands
- Eastside (Interior) Grasslands
- Shrub-steppe
- Dwarf Shrub-steppe
- Desert Playa & Salt Scrub

Developed Habitats
- Agriculture, Pasture & Mixed Environs
- Urban & Mixed Environs

Aquatic & Riparian Habitats
- Lakes, Rivers, Ponds & Reservoirs
- Herbaceous Wetlands
- Westside Riparian - Wetlands
- Montane Coniferous Wetlands
- Eastside (Interior) Riparian - Wetlands



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SOURCE: WDFW and Northwest Habitat Institute, 1999.

FIGURE 3-13

CURRENT WILDLIFE HABITAT TYPES

COLUMBIA RIVER WATER MANAGEMENT PROGRAM EIS

WASHINGTON

3.7.2.1 Federally and State-Listed Plant Species

The Management Program area contains plant species that are listed as endangered or threatened under the ESA (50 CFR Part 17). The USFWS lists seven plant species that occur in the Management Program area as endangered or threatened, and identifies an additional five species as candidates for listing (Table 3-17). (USFWS 2005a; 2005b). Forty plant species are considered federal species of concern and may occur in the project area. Table 3-18 also shows the state designation for federally listed plants. Additional state-listed species are discussed in Section 3.7.2.2.

Table 3-18. Federally Listed Plant Species

Common Name	Scientific Name	Federal Status	State Status	Habitat
Bradshaw's Lomatium	*Lomatium bradshawii*	Endangered	Endangered	Wet prairie/ grassland
Showy Stickseed	*Hackelia venusta*	Endangered	Endangered	Granite / talus
Wenatchee Mountain Checker-mallow	*Sidalcea oregana var. calva*	Endangered	Endangered	Moist meadow
Water Howellia	*Howellia aquatilis*	Threatened	Threatened	Seasonally dry areas of wetlands
Nelson's Checker-mallow	*Sidalcea nelsoniana*	Threatened	Endangered	Open grassland / moist areas
Spalding's Silene	*Silene spaldingii*	Threatened	Threatened	Open grasslands
Ute Ladies' Tresses	*Spiranthes diluvialis*	Threatened	Endangered	Intermontane valley plains
Basalt Daisy	*Erigeron basalticus*	Candidate	Threatened	Basalt cliffs
Northern Wormwood	*Artemisia campestris ssp. borealis var. wormskioldii*	Candidate	Endangered	Shrub-steppe
Slender Moonwort	*Botrychium lineare*	Candidate	Threatened	Forest floodplain
Umtanum Desert Buckwheat	*Eriogonum codium*	Candidate	Endangered	Basalt cliffs
White Bluffs Bladderpod	*Lesquerella tuplashensis*	Candidate	Threatened	Sagebrush – highly alkaline/dry soil
Ames' Milk-vetch	*Astragalus pulsiferae var. suksdorfii*	Species of Concern	Endangered	Open Ponderosa Pine forest
Barrett's Beardtongue	*Penstemon barrettiae*	Species of Concern	Threatened	Basalt cliffs / talus / other rocky areas
Blue Mountain Onion	*Allium dictuon*	Species of Concern	Threatened	Steep slopes, gravelly soil
Broad-fruit Mariposa	*Calochortus nitidus*	Species of Concern	Endangered	Grassland / moist swales
Chelan Rockmat	*Petrophyton cinerascens*	Species of Concern	Endangered	Basalt cliffs
Clackamas Corydalis	*Corydalis aquae-gelidae*	Species of Concern	Sensitive	Coniferous forest – riparian
Clustered Lady's-slipper	*Cypripedium fasciculatum*	Species of Concern	Sensitive	Coniferous forest

Common Name	Scientific Name	Federal Status	State Status	Habitat
Columbia Milk-vetch	*Astragalus columbianus*	Species of Concern	Sensitive	Shrub-steppe
Crenulate Moonwort	*Botrychium crenulatum*	Species of Concern	Sensitive	Moist areas – coniferous forest
Gorge Daisy	*Erigeron oreganus*	Species of Concern	Threatened	Basalt cliffs
Gray Cryptantha	*Cryptantha leucophaea*	Species of Concern	Sensitive	Sandy soils – Columbia riparian
Hoover's Desert-parsley	*Lomatium tuberosum*	Species of Concern	Sensitive	Loose talus
Hoover's Tauschia	*Tauschia hooveri*	Species of Concern	Threatened	Shrub-steppe
Howell's Daisy	*Erigeron howellii*	Species of Concern	Threatened	Thin soils, steep slope
Jessica's Aster	*Aster jessicae*	Species of Concern	Endangered	Palouse grassland
Least Phacelia	*Phacelia minutissima*	Species of Concern	Endangered	Wet meadow
Liverwort Monkey-flower	*Mimulus jungermannioides*	Species of Concern	Extinct?	Basalt cliffs
Long-bearded Sego Lily	*Calochortus longebarbatus var. longebarbatus*	Species of Concern	Sensitive	Coniferous forest
Northwest Raspberry	*Rubus nigerrimus*	Species of Concern	Endangered	Wet meadow / drainages
Obscure Buttercup	*Ranunculus reconditus*	Species of Concern	Endangered	Meadow-steppe
Obscure Indian-paintbrush	*Castilleja cryptantha*	Species of Concern	Sensitive	Sub-alpine meadows / parklands – Mt. Rainier Nat'l Park
Oregon Sullivantia	*Sullivantia oregana*	Species of Concern	Endangered	Moist cliffs
Pale Blue-eyed Grass	*Sisyrinchium sarmentosum*	Species of Concern	Threatened	Seasonally moist meadows
Palouse Goldenweed	*Haplopappus liatriformis*	Species of Concern	Threatened	Grasslands
Persistentsepal Yellowcress	*Rorippa columbiae*	Species of Concern	Endangered	Near water
Seely's Silene	*Silene seelyi*	Species of Concern	Sensitive	Basalt cliffs / talus
Stalked Moonwort	*Botrychium pedunculosum*	Species of Concern	Sensitive	Meadow / perennial streams / coniferous forest
Sticky Phacelia	*Phacelia lenta*	Species of Concern	Threatened	Basalt cliffs

Common Name	Scientific Name	Federal Status	State Status	Habitat
Suksdorf's Desert-parsley	*Lomatium suksdorfii*	Species of Concern	Sensitive	Rocky hillsides – moderate to steep slopes
Tall Bugbane	*Cimicifuga elata*	Species of Concern	Sensitive	Coniferous forest
Thompson's Clover	*Trifolium thompsonii*	Species of Concern	Threatened	Open coniferous forest / grassland
Torrey's Peavine	*Lathyrus torreyi*	Species of Concern	Threatened	Info not available
Triangular-lobed Moonwort	*Botrychium ascendens*	Species of Concern	Sensitive	Coniferous forest / meadows / ravines
Two-spiked Moonwort	*Botrychium paradoxum*	Species of Concern	Threatened	Forest floodplain / stream terraces
Wanapum Crazyweed	*Oxytropis campestris var. wanapum*	Species of Concern	Endangered	Open grassland / shrubland
Washington Polemonium	*Polemonium pectinatum*	Species of Concern	Threatened	Sagebrush
Wenatchee Larkspur	*Delphinium viridescens*	Species of Concern	Threatened	Moist meadows – open areas
White Meconella	*Meconella oregana*	Species of Concern	Threatened	Open grassland
Whited's Milk-vetch	*Astragalus sinuatus*	Species of Concern	Endangered	Rocky hillsides
White-top Aster	*Aster curtus*	Species of Concern	Sensitive	Open grassland

Federal Listings, under the Endangered Species Act – as published in the Federal Register:

· Endangered = Listed Endangered. In danger of extinction.
  Threatened = Listed Threatened. Likely to become endangered.

· Candidate = Candidate species. Sufficient information exists to support listing as Endangered or Threatened.
  Species of Concern = An unofficial status. The species appears to be in jeopardy, but insufficient information exists to support listing.

State Listings, as determined by the Washington Natural Heritage Program:

· Endangered = In danger of becoming extinct or extirpated from Washington.

· Threatened = Likely to become Endangered in Washington.

· Sensitive = Vulnerable or declining and could become Endangered or Threatened in the state.

3.7.2.2 Washington State-Listed Species

The Washington Natural Heritage Program (WNHP) was created in 1981 within the state Department of Natural Resources to protect natural areas within the state (RCW 79.70.030). The WNHP classifies and maintains an inventory of rare plant species in the state. Currently, there is no state law protecting rare plant species in Washington, but many federal and state land management agencies have policies that provide protection for rare species.

Table 3-18 includes the state designation for the federally listed plant species. In addition to those species, there are 253 species designated by the state that occur in the project area. Of the 253 species, 32 are considered endangered, 86 are threatened, 125 are sensitive, and 10 are possibly extinct in the state of Washington. Appendix I contains a complete list of these species and includes a brief description of habitat for each species.

3.7.2.3 Washington Natural Heritage Program (WNHP)

WNHP maintains a database of the information available for rare plant species and endangered ecosystems in the state. Data include the presence, population size, condition, protection status, and distribution of elements of natural diversity. Listed plant species occur in a variety of habitats in the Management Program area. The immense variety of plant communities in the project area prevents an exhaustive description of each community and associated listed species.

3.7.2.4 Early Action Study Areas

Lake Roosevelt Drawdown

Lake Roosevelt extends through multiple vegetation communities within the 150 miles between the Grand Coulee Dam and the Canadian border. The lake occurs in a transition zone between the arid steppe environment of the Columbia River Basin and the dry forest of the Okanogan Highlands. The northern portion of the lake is adjacent to conifer forests dominated by ponderosa pine, while the southern portion occurs within the developed shrub-steppe zone that contains modified shrub and grasslands. Sparse riparian wetlands are present along the banks of the lake; however, the dramatic fluctuation of lake levels during the year prevents establishment of extensive riparian vegetation.

Odessa Ground Water Management Subarea

The study area for the Odessa Subarea lies within the shrub-steppe community described above. Much of the area has been converted to agricultural land irrigated by ground water. According to Ecology, many creeks, draws, and natural springs have dried up due to the extensive ground water pumping in the area (Reclamation 2006c,d). Two listed plant species may occur in the Odessa subarea—Ute ladies'-tresses and Spalding's catchfly (Reclamation 2006c,d).

Supplemental Feed Route

The three possible Supplemental Feed Routes extend through agricultural lands that are part of the Columbia Basin Project. Scattered areas of shrub-steppe vegetation remain in a fragmented landscape, but much of this central basin contains irrigated farmlands or dry modified grassland and pasture. Natural spring-fed wetlands are present north of Moses Lake along the Crab Creek drainage, and lakes and pothole wetlands are present west of Potholes Reservoir.

Crab Creek Route Alternative

The Crab Creek route extends along a natural channel that supports ephemeral stream flow. The streambed is primarily located through native shrub-steppe with some scattered grasslands. Areas of intact microbiotic crust are present along the route in shrub-steppe areas. Pothole and marsh wetlands fed by ground water seeps and dominated by cattail, willow, sedges, and rushes are also present along the stream corridor. Much of the Crab Creek drainage is designated by WDFW as the North Columbia Basin Wildlife Area (Gloyd Seeps Unit). The area is 8,000 acres and includes thousands of small lakes, potholes, and seeps.

W20 Route Alternative

The W20 Canal route extends through irrigated agricultural areas or dry modified grasslands. Very little shrub-steppe or wetland habitat is present along this route. The proposed new conveyance route that will connect the existing W20 Canal to Moses Lake contains dry grassland dominated primarily by cheatgrass.

Frenchman Hills Route Alternative

The Frenchman Hills Route extends through two different vegetation communities. The Main Canal and West Canal are bordered by irrigated agricultural fields or dry fallow pastures. The Frenchman Hills Wasteway extends through an area containing multiple lakes, ponds, and pothole wetlands as well as scattered areas of shrub-steppe. WDFW has designated a large area north of the wasteway as the Desert Wildlife Area. The area is 35,000 acres and contains shrub-steppe, sand dunes, marsh, and lake habitats, along with wasteways and canals. According to WDFW, the area was a desert prior to the Columbia Basin Project (WDFW 2000). The basin now serves as a collector for irrigation water from upslope farmlands and contains a mosaic of wetlands and desert uplands. In addition to naturally occurring shrub-steppe communities, many acres are dominated by non-native grasses such as cheatgrass.

Potholes Reservoir and Moses Lake

The Moses Lake area includes developed areas along the lake and fringe wetland communities. The Potholes Reservoir is located in a 32,500-acre Wildlife Area managed by WDFW. According to WDFW, the water levels fluctuate widely during the year, occasionally covering sand dune areas or seasonally flooded forests dominated by willow (WDFW 2000). Higher-elevation wetlands on the northern and western fringes of the reservoir have cattail and bulrush communities. The west side of the Potholes area still has sand dunes and shrub-steppe habitat. The eastern portion is mostly sand, gravel, and round-rock soil, with shrub-steppe vegetation bordered by irrigated farmland.

The USFWS also manages the Columbia National Wildlife Refuge that includes the Potholes Reservoir and scattered lakes to the south. The refuge is 23,000 acres in the channeled scablands of the Columbia River Basin and contains numerous small- to medium-sized lakes surrounded by sagebrush and grasslands, canyons, and buttes (USFWS 2006).

3.7.3 Terrestrial Wildlife

This section describes terrestrial wildlife in the Management Program study area. The study area contains diverse habitat types of conifer and mixed forest, shrub-steppe, and wetlands that provide a wide range of microclimates, food sources, and niches for waterfowl and wildlife (Figure 3-13).

3.7.3.1 Wildlife Habitat

Eastern Washington forests provide a wide range of habitats and associated elements for numerous terrestrial wildlife species. For example, they provide snags for cavity-nesting birds and roosting bats, such as chickadees, nuthatches, woodpeckers, and myotis bats. Forests also contain downed wood for breeding salamanders, such as Larch mountain salamander, and multistory vegetation under a closed canopy for songbirds and small mammals, including yellow-pine chipmunk and western red-backed vole. Regenerating shrub/seedling areas provide habitat elements for rodents and reptiles such as American pika and meadow vole. According to the wildlife habitat matrices produced by Johnson and O'Neil, there are 287 vertebrate wildlife species that inhabit forests and woodlands of eastern Washington (Johnson and O'Neil 2001).

Shrub-steppe habitats provide fewer vegetation layers, which results in a lower diversity of wildlife species than dry forests. However, several species are dependent on this habitat, including pygmy rabbit, Washington ground squirrel, striped whipsnake, and sagebrush vole. High temperatures and limited precipitation strongly shape the composition of plant communities in these arid and semi-arid habitats and influence the ecology and behavior of associated wildlife (Vander Haegen et al. 2001). Habitats containing woody shrubs tend to have more diverse wildlife communities than grass-dominated habitats, which is a function of increased vegetation layers for nesting and foraging. Due to their close association with this habitat, several birds are considered sagebrush obligates, including sage and Brewer's sparrows, sage thrasher, and both sage and sharp-tailed grouse (Dobler et al. 1996; USFWS 2006). Long-billed curlew and savannah sparrow are also found in shrub-steppe habitats with a larger true steppe or grassland component. According to the wildlife habitat matrices produced by Johnson and O'Neil, there are 22 birds, 12 mammals, 6 reptiles, and 1 amphibian associated with shrub-steppe habitat that require shrubs for a particular life function (Vander Haegen et al. 2001). Approximately 184 species are found in the shrub-steppe environments.

Due to the decline in shrub-steppe habitat in the Columbia Basin and Plateau, species associated with this habitat have also severely declined. Bird species associated with shrub-steppe are of high management concern to resource agencies, and conservation of remaining habitat is important for long-term survival for multiple species (Vander Haegen et al. 2005). Less is known about mammals, amphibians, and reptiles associated with shrub-steppe habitat, but declines associated with habitat loss are suspected.

Riparian areas provide critical wildlife habitat for an abundance of species. Riparian habitats occur in linear bands connecting aquatic and terrestrial habitats, thus providing natural corridors or migration routes for birds. The convergence of upland and wetland areas results in a high diversity of plant species, complex vegetation structure, microclimates, and a variety of habitat features for wildlife (Kauffman et al. 2001; Knutson and Naef 1997). Forested riparian habitat offers an abundance of snags that provide breeding habitat for cavity-nesting birds and mammals, and a food source for insect-eating birds. Amphibians and small mammals find shelter in or under downed trees and under dense vegetation and rely on the predictable water source. The high density of prey species makes riparian areas favored habitats for foraging reptiles (Kauffman et al. 2001). Large animals such as deer, elk, and moose can seek refuge from summer temperatures in relatively cool riparian zones (Knutson and Naef 1997). Riparian areas provide breeding habitat for more species of birds than any other vegetation type while comprising a small percentage of the landscape (Kauffman et al. 2001). According to the wildlife habitat matrices produced by Johnson and O'Neil, approximately 271 species are associated with riparian wetlands.

Agriculture and pasture grasslands provide habitat for a high number of wildlife species because they are widely distributed and contain a matrix of other habitats. Developed areas also provide ephemeral or man-made wetlands, wells and other water sources, shelterbelts, hedgerows, field borders, and desert dwellings or other structures. Western meadowlark and horned lark are common grassland species that have adapted well to agricultural land. Low-intensity agriculture crops, such as wheat, corn, and barley, provide more benefit for wildlife compared to high-value crops such as orchards and vineyards (WDFW personal communication 2006). Higher value crops provide less food and are more intensely managed. Management may result in a high amount of chemical exposure to wildlife and a reduced tolerance of wildlife eating the high-value crops. According to the wildlife habitat matrices produced by Johnson and O'Neil, approximately 346 species are associated with agricultural lands that include grasslands and urban environments.

3.7.3.2 Federal and State-Listed Wildlife Species

The USFWS lists nine wildlife species that occur in the Management Program project area as endangered or threatened; eight species that are candidates for listing; and 34 species of concern (USFWS 2005a; USFWS 2005b). These species may occur in any of the counties within the project area. Table 3-19 lists all of the federally listed wildlife species and their status in Washington state.

Table 3-19. Federally Listed Wildlife Species

Common Name	Scientific Name	Federal Status	State Status	Habitat
pygmy rabbit	*Brachylagus idahoensis*	Endangered	Endangered	Shrub-steppe
gray wolf	*Canis lupus*	Endangered	Endangered	Riparian / upland forest / shrub-steppe
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	Endangered	Endangered	Upland forest
woodland caribou	*Rangifer tarandus caribou*	Endangered	Endangered	Upland forest with riparian
bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened	Large rivers
Canada lynx	*Lynx canadensis*	Threatened	Threatened	High elevation upland forest
grizzly bear	*Ursus arctos horribilis*	Threatened	Endangered	Upland forest
marbled murrelet	*Brachyramphus marmoratus*	Threatened	Threatened	Old-growth forest
northern spotted owl	*Strix occidentalis caurina*	Threatened	Endangered	Old-growth forest
Columbia spotted frog – Great Basin DPS	*Rana luteiventris*	Candidate	Candidate	Riparian / wetland
fisher – West Coast DPS (west of Okanogan River)	*Martes pennanti*	Candidate	Endangered	Upland forest
greater sage grouse – Columbia Basin DPS	*Centrocercus urophasianus*	Candidate	Threatened	Shrub-steppe
Mardon skipper	*Polites mardon*	Candidate	Endangered	Grassland / prairie
Oregon spotted frog	*Rana pretiosa*	Candidate	Endangered	Riparian / wetland

Common Name	Scientific Name	Federal Status	State Status	Habitat
Washington ground squirrel	*Spermophilus washingtoni*	Candidate	Candidate	Grassland
Mazama pocket gopher	*Thomomys mazama*	Candidate	Threatened	Grassland / prairie
streaked horned lark	*Eremophila alpestris strigata*	Candidate	Endangered	Grassland / prairie
yellow-billed cuckoo	*Eremophila alpestris*	Candidate	Candidate	Forested riparian
black swift	*Cypseloides nige*	Species of Concern		Mountainous / forested riparian
burrowing owl	*Athene cunicularia*	Species of Concern	Candidate	Grassland / prairie
California wolverine	*Gulo gulo luteus*	Species of Concern		Above timberline / forest (winter)
Cascades frog	*Rana cascadae*	Species of Concern	Monitor	Wet mountain areas / open coniferous forest
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	Species of Concern	Threatened	Grassland / shrub savanna
Columbia torrent salamander	*Rhyacotriton kezeri*	Species of Concern	Endangered	Mountain stream riparian
ferruginous hawk	*Buteo regalis*	Species of Concern	Threatened	Grassland / prairie / shrub-steppe / desert
fisher (east of Okanogan River)	*Martes pennanti*	Species of Concern	Endangered	Coniferous forest
Kincaid meadow vole	*Microtus pennsylvanicus kincaidi*	Species of Concern	Monitor	Prairie
larch mountain salamander	*Plethodon larselli*	Species of Concern	Sensitive	Mossy talus slopes / caves
loggerhead shrike	*Lanius ludovicianus*	Species of Concern	Candidate	Grassland / shrub-steppe
long-eared myotis	*Myotis evotis*	Species of Concern	Monitor	Forest
long-legged myotis	*Myotis volans*	Species of Concern	Monitor	Forest
northern goshawk	*Accipiter gentilis*	Species of Concern	Candidate	Mature forest – mid/upper elevations
northern leopard frog	*Rana pipiens*	Species of Concern	Endangered	Open grassland
northwestern pond turtle	*Clemmys marmorata marmorata*	Species of Concern		Wetland areas
olive-sided flycatcher	*Contopus cooperi*	Species of Concern		Disturbed forest
Pacific Townsend's big-eared bat	*Corynorhinus townsendii townsendii*	Species of Concern	Candidate	Caves – forest and shrub grassland

Common Name	Scientific Name	Federal Status	State Status	Habitat
pallid Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	Species of Concern	Candidate	Desert / grassland – manmade structures
Preble's shrew	*Sorex preblei*	Species of Concern	Monitor	Open areas / forest
Rocky Mountain-tailed frog	*Ascaphus montanus*	Species of Concern	Candidate	Streams within forest
sagebrush lizard	*Sceloporus graciosus*	Species of Concern	Candidate	Sagebrush / desert shrub
sharptail snake	*Contia tenius*	Species of Concern	Candidate	Seasonally moist areas
slender-billed white-breasted nuthatch	*Sitta carolinensis aculeate*	Species of Concern	Candidate	Ponderosa pine / other forest
tailed frog	*Ascaphus truei*	Species of Concern	Monitor	Streams within mature forest
Townsend's ground squirrel	*Spermophilus townsendii*	Species of Concern	Candidate	Grassland / sagebrush
Van Dyke's salamander	*Plethodon vandykei*	Species of Concern	Candidate	Streams / rock outcrops
western gray squirrel	*Sciurus griseus griseus*	Species of Concern	Threatened	Oak woodland
western pond turtle	*Clemmys marmorata*	Species of Concern	Endangered	Ponds and lakes
western toad	*Bufo boreas*	Species of Concern	Candidate	Prairies / forest / grassland
wolverine	*Gulo gulo*	Species of Concern	Candidate	High elevation forest
giant Columbia spire (snail)	*Fluminicola Columbiana*	Species of Concern		Fast-moving rivers
Columbia clubtail (dragonfly)	*Gomphus lynnae*	Species of Concern	Candidate	Clear streams
Valley silverspot (butterfly)	*Speyeria zerene bremeri*	Species of Concern		Oak woodland
Willow flycatcher	*Empidonax traillii*	Species of Concern		Willow thickets / riparian
black tern	*Childonias niger*	Species of Concern	Monitor	Freshwater (nesting) / marine (winter)
Oregon vesper sparrow	*Pooecetes gramineus affinis*	Species of Concern	Candidate	Grassland / sagebrush / shrub-steppe

Endangered: Species are in danger of extinction within the foreseeable future throughout all or a significant portion of range.
Threatened: Species are likely to become endangered within the foreseeable future.
Candidate: Species is on waiting list for federal listing consideration.
Species of Concern: Species about which there is some concern regarding status and threats to the species, but for which insufficient information is available to indicate a need to list the species under the ESA.
DPS = distinct population segment

3.7.3.3 Washington State-Listed Species

In addition to the species listed in Table 3-19, the Management Program area contains several other species listed by WDFW as endangered, threatened, candidate, sensitive or monitor. These species are listed in Table 3-20 and key species are discussed in more detail in the following section.

Table 3-20. State Listed Wildlife Species

Common Name	Scientific name	State Status	Habitat
Townsend's big-eared bat	*Coryhorhinus townsendii*	Candidate	Caves / Mixed conifer forest
Keen's myotis	*Myotis keenii*	Candidate	Caves / Mixed conifer forest
fringed myotis	*Myotis thysanodes*	Monitor	Caves / Mixed conifer forest
small-footed myotis	*Myotis ciliolabrum*	Monitor	Caves / Cliffs / Talus
golden eagle	*Aquila chrysaetos*	Candidate	Cliffs / Mixed conifer forest / Shrub-steppe
western grebe	*Aechmophorus occidentalis*	Candidate	Freshwater wetlands (breeding)
American white pelican	*Pelecanus erythrorhynchos*	Endangered	Freshwater wetlands and fresh deepwater (nesting)
upland sandpiper	*Bartramia langicauda*	Endangered	Grasslands
Cathlamet pocket gopher	*Thomomys mazama louiei*	Candidate	Grasslands – Wahkiakum County
gray-tailed vole	*Microtus canicaudus*	Candidate	Grasslands / Agriculture
sandhill crane	*Grus Canadensis*	Endangered	Grasslands / Herbaceous wetlands (near forest)
peregrine falcon	*Falco peregrinus*	Sensitive	Grasslands / Urban / Cliffs
Common loon	*Gavial immer*	Sensitive	Lakes (breeding)
Beller's ground beetle	*Agonum belleri*	Candidate	Lowland sphagnum bogs
Hatch's click bettle	*Eanus hatchii*	Candidate	Lowland sphagnum bogs
long-horned leaf bettle	*Donacia idola*	Candidate	Lowland sphagnum bogs
flammulated owl	*Otus flammeolus*	Candidate	Mixed conifer forest
merlin	*Falco columbarius*	Candidate	Mixed conifer forest
pileated woodpecker	*Dryocopus pileatus*	Candidate	Mixed conifer forest
black-backed woodpecker	*Picoides arcticus*	Candidate	Mixed conifer forest (mid to high elevation)
Lewis' woodpecker	*Melanerpes lewis*	Candidate	Mixed conifer forest, Riparian, Oregon white oak forest
Aleutian Canada goose	*Branta Canadensis leucopareia*	Monitor	Offshore islands (nesting) / Grasslands, agriculture (winter)
Vaux's swift	*Chaetura vauxi*	Candidate	Old growth forest/Mature forest / Open areas (foraging)
white-headed woodpecker	*Picoides albolarvatus*	Candidate	Ponderosa pine forest and woodlands
red-legged frog	*Rana aurora*	None	Riparian

Common Name	Scientific name	State Status	Habitat
purple martin	*Progne subis*	Candidate	Rural and urban natural open space (near water)
black-tailed jackrabbit	*Lepus californicus*	Candidate	Shrub steppe
white-tailed jackrabbit	*Lepus townsendii*	Candidate	Shrub steppe
sage sparrow	*Amphispiza belli*	Candidate	Shrub steppe / Grasslands
Merriam's shrew	*Sorex merriami*	Candidate	Shrub steppe / Ponderosa pine forest and woodlands/Grasslands
sage thrasher	*Oreoscoptes montanus*	Candidate	Shrub-steppe
striped whipsnake	*Masticophis taeniatus*	Candidate	Shrub-steppe
Cascade torrent salamander	*Rhyacotriton cascade*	Candidate	Streams, rivers
Columbia river tiger beetle	*Cicindela columbica*	Candidate	Streams, rivers
Mann's mollusk-eating ground beetle	*Scaphinotus mannii*	Candidate	Streams, rivers
Dunn's salamander	*Plethodon dunni*	Candidate	Streams, rivers / Mixed conifer forest
Olympic torrent salamander	*Rhyacotriton olympicus*	Monitor	Streams, rivers / Mixed conifer forest

State Endangered Species: Any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.
State Threatened Species: Any wildlife species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.
State Sensitive Species: Any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range within the state without cooperative management or removal of threats.
State Candidate Species: Include fish and wildlife species that the Department will review for possible listing as State Endangered, Threatened, or Sensitive. A species will be considered for designation as a State Candidate if sufficient evidence suggests that its status may meet the listing criteria defined for State Endangered, Threatened, or Sensitive.

3.7.3.4 State Priority Habitat and Species (PHS) Program

The WDFW PHS database contains information on wildlife and habitat resources in the Management Program area. Terrestrial wildlife listed as state priority species are described below in major priority categories, with an example of species present in the Columbia River system for each category.

The WDFW has also published management recommendations for priority habitats and species, including several that are found in the Management Program area. In general, the recommendations include suggested protective buffer distances, timing restrictions, conservation of certain habitat types near known wintering or breeding areas, restrictions on land uses and human activities adjacent to nesting sites, etc. The WDFW recommendations do not have regulatory authority, but provide scientifically based guidance for protecting priority habitats and species. The management recommendations are grouped into invertebrates, amphibians and reptiles, birds, and mammals. WDFW also provides recommendations for riparian habitats.

Amphibians

Priority species of amphibians in the project area include the spotted frog, a state endangered species and federal candidate species, and the northern leopard frog. Priority salamanders primarily occur in the southwest portion of the project area and include five state candidate species, including Dunn's salamander, larch mountain salamander, Cascade and Olympic torrent salamanders, and Van Dyke's salamander (WDFW 2006). Van Dyke's salamander is also a federal species of concern.

Reptiles

There are several priority species of reptiles (e.g., snakes, lizards and turtles) in the project area. Reptiles within the project area include the sagebrush lizard, striped whipsnake, and sharptail snake (WDFW 2006). All three are state candidate species and the sagebrush lizard is a species of concern. The western pond turtle is a state endangered species and a federal species of concern.

Birds

Priority bird species in the project area include waterfowl (Aleutian Canada goose, common loon, western grebe); raptor (golden eagle, ferruginous hawk); upland game birds (sage grouse, sharp-tailed grouse); crane (sandhill crane); shorebird (upland sandpiper, snowy plower); owl (burrowing owl); woodpecker (Lewis' woodpecker, white-headed woodpecker, black-backed woodpecker); and perching birds (sage sparrow, sage thrasher, streaked horned lark) (WDFW 2006). There are specific WDFW PHS management recommendations for several bird species in the Management Program area, including common loon, burrowing owl, sandhill crane, great blue heron, and ferruginous hawk.

Mammals

Mammals in the project area include the priority species categories of bat (Townsend's big-eared bat); rabbit (pygmy rabbit, black-tailed jackrabbit); rodent (Washington ground squirrel, western gray squirrel, western pocket gopher, sagebrush vole); and big game ungulates (Columbian white-tailed deer) (WDFW 2006).

Key Wildlife Population Status and Habitat Conditions

Similar to ESA-listed fish species, wildlife habitat and recovery efforts are critical components of large-scale water resource management efforts and will be addressed in more detail below. The following discussion is based on available information and is segregated into species important to the management effort.

<u>Pygmy Rabbit</u>. Pygmy rabbits are dependent on sagebrush habitats, particularly dense stands of big sagebrush. The Columbia Basin pygmy rabbit population is genetically distinct and isolated from other pygmy rabbit populations in the Great Basin (USFWS 2004). Pygmy rabbits have declined severely in the Columbia Basin largely due to habitat loss and fragmentation (WDFW 1995). In 1997, only six populations were known, and surveys in 2004 found no rabbits at historic sites (WDFW 2003). According to WDFW (2003), less than 30 rabbits are believed to remain in the wild. In 2001, WDFW began a captive breeding program for this species.

Sage Grouse. This upland game species also inhabits shrub-steppe habitats and has declined due to conversion of shrub-steppe habitats to agricultural crop production. Degradation of habitat due to overgrazing and the increase of cheatgrass and noxious weeds into shrub-steppe habitats have also impacted populations (WDFW 2004). Two populations of sage grouse remain in Washington; one in Douglas and Grant Counties and the other on the Yakima Training Center lands (Hays et al. 1998). According to WDFW's recovery plan for this species, neither isolated population is large enough for long-term viability (WFDW 2004).

Sharp-tailed Grouse. Similar to sage grouse, sharp-tailed grouse lives in shrub-steppe communities and their populations are in decline due to habitat loss. The sharp-tailed grouse need grass-dominated habitat for nesting and deciduous shrub-dominated habitats for wintering (Shroeder et al. 2000). The current distribution of grouse is less than 3 percent of its historic distribution, composed of small and isolated populations in Okanogan, Douglas, and Lincoln Counties (Shroeder et al. 2000).

Washington Ground Squirrel. As with sage grouse, the Washington ground squirrel occupies shrub-steppe habitats and is in decline due to the loss of this habitat. The Washington ground squirrel is endemic to the Columbia Plateau, but now occurs in three disjunct areas in Washington and northeast Oregon (Betts 1999). The squirrel is closely associated with areas containing deep, silty soils with significant grass and forb cover. Tilling and other mechanisms involved in conversion of shrub-steppe habitats remove the species' food source, and render the soils necessary for burrowing unusable (Betts 1999).

Columbia Spotted Frog. The Columbia spotted frog was differentiated from the Oregon spotted frog in 1996. Their range has dramatically decreased in the last 50 years although the causes of decline are not fully understood. Spotted frogs are highly aquatic and live in or near permanent bodies of water, including lakes, ponds, slow streams and marshes (Leonard et al. 1993). Columbia spotted frogs lay their eggs in the shallows of a permanent water source between March and April in lower elevations in the Columbia Basin. The major threats to Columbia spotted frog are likely the destruction and degradation of wetlands and the introduction of non-native predators such as bullfrogs (Leonard 2006).

Northern Leopard Frog. This frog is a state endangered species and a federal species of concern. The northern leopard frog has declined in Washington due to habitat loss, agricultural chemicals, and non-native species such as bullfrog. In 1999, WDFW found the remaining leopard frogs in Washington occurring in the Crab Creek drainage (WDFW 1999).

Sandhill Crane. Two populations of sandhill cranes occur in Washington. A large migratory population, comprised of about 23,000 birds, stops in eastern Washington during migration between winter grounds in California and breeding grounds in Alaska or Canada (Littlefield and Ivey 2002). An additional 3,000 birds stop on the lower Columbia River in the southwest portion of the state. These wintering birds feed in open prairie, agricultural fields, and river valleys.

A small breeding population of sandhill crane occurs in the state, but is currently restricted to Klickitat and Yakima Counties. These birds nest in emergent wetlands surrounded by conifer forest. A decline in breeding birds is attributed to habitat loss and predation. Habitat loss is due to industrial development, conversion of agricultural lands to cottonwood plantations, tree nurseries, or other incompatible uses (Littlefield and Ivey 2002).

American White Pelican. American white pelicans breed and summer in the Columbia River Basin of eastern Washington. Although most individuals winter along the Pacific Coast, a small number of breeding birds stay and winter in eastern Washington. Many non-breeding individuals remain in eastern Washington year-round, utilizing inland waters. This species requires shallow water for foraging on amphibians, crustaceans, and warmwater fish. Breeding colonies are found on isolated islands in freshwater lakes and occasionally on islands in rivers. Habitat destruction is one of the most important limiting factors for the American white pelican. Water depth fluctuations may adversely affect habitat quality. High water levels have potential to flood the ground nests in the breeding colonies (Larsen et al. 2004 and references therein). Changes in water depth and temperature may change the prey base this species requires.

3.7.3.5 Early Action Study Areas

Lake Roosevelt Drawdown

The shoreline around Lake Roosevelt contains grass and shrub habitats adjacent to conifer forests and riparian wetlands. These habitats support an estimated 75 mammal species (including mule deer, coyote, and black bear); 200 species of birds (including bald eagle, osprey, and western meadowlark); 10 species of amphibians; and 15 species of reptiles (NPS 2005).

Supplemental Feed Route

The three possible Supplemental Feed Routes extend through agricultural and pasture habitats, shrub-steppe habitat, and wetlands.

Crab Creek Route Alternative. Wildlife species typical of shrub-steppe, grassland, and wetland habitats are present along the Crab Creek route. The mosaic of habitats along the stream corridor provides suitable nesting and foraging for a large number of species. According to WDFW (2000), the Gloyd Seeps Unit supports abundant waterfowl, such as Canada geese, redheads, canvasbacks, ruddy ducks, blue- and green-winged teal, and pintail (WDFW 2000). Shorebirds and Caspian terns, pelicans, sandhill cranes, and swans are associated with open water areas. Ring-billed gulls; Brewer's, red-winged, and yellow-headed blackbirds; killdeer; meadowlarks; and horned larks occur in grassland habitats. Raptors such as prairie falcons, ferruginous hawks, red-tailed and Swainson's hawks, and golden eagles are present. Game birds including pheasant, chukar and Hungarian partridge, and quail are common. Mammals include coyote, jackrabbit, marmot, ground squirrel, muskrat, mice, and shrew. Mule deer occur in fringe areas where suitable habitat exists. Amphibians, including northern leopard frog, also occur in wetland habitats.

W20 Route Alternative. Wildlife species along the W20 route are primarily associated with dry grasslands and developed areas. Wildlife adapted to agriculture, including white-crowned sparrow and blackbird, are present along this route.

Frenchman Hills Route Alternative. Wildlife species along the Main Canal and West Canal are typical of irrigated fields or dry pastures. A diverse assemblage of wildlife is present along the Frenchman Hills Wasteway portion of the route. Multiple species of ducks breed in the lakes and ponds, as well as shorebirds such as black-necked stilt, American avocet, and Wilson's phalarope. The Desert Wildlife Area provides a mosaic of habitats for over 150 species of wildlife similar to those species described for Crab Creek.

Potholes Reservoir and Moses Lake. The Moses Lake area includes developed habitats along the lake and fringe wetland habitats. The Columbia National Wildlife Refuge that includes the Potholes Reservoir also provides a mosaic of habitats for over 150 species of wildlife similar to those species described for Crab Creek. The refuge is a wintering area for an average population of more than 100,000 ducks and Canada geese (USFWS 2006).

Odessa Ground Water Management Subarea. Wildlife in the Odessa Subarea is typical of agricultural and modified grassland habitat types. Due to the significant modification of historic shrub-steppe habitats, only fragmented patches remain. In addition to the 13 anadromous fish species listed under the ESA by NOAA Fisheries, listed terrestrial wildlife that may occur in the study area include the bald eagle and pygmy rabbit (Reclamation 2006c,d). A large population of migratory mule deer is also present in the area (WDFW personal communication 2006).

3.8 Socioeconomics

The proposed alternatives might affect five distinct components of socioeconomic conditions in Washington: (1) the value of water-related goods and services; (2) the level and composition of jobs and incomes; (3) the distribution among different groups of the costs and benefits resulting from management of water resources; (4) the socioeconomic structure; and (5) economic risk and uncertainty. These factors are discussed below.

While not an element required under SEPA, this analysis of socioeconomics is included in this EIS to provide a general understanding of the potential economic impacts of the proposed Management Program. More detailed economic evaluations would be conducted for some specific projects, including a cost-benefit analysis for major storage projects.

3.8.1 Regional Economic Setting

3.8.1.1 Value of Goods and Services

Water and related resources are economically important when, as part of an ecosystem, they produce *goods and services*, such as those illustrated in Table 3-21, that benefit people, impose costs on them, or both (National Research Council 2005). The value of a good or service generally is measured in terms of the amount of money people are willing to pay to acquire it or the amount they require as compensation to relinquish it. Some goods and services have value when people use the basin's water and related resources, as when irrigators remove water from the river to irrigate crops, anglers fish in a reservoir, or developers build homes overlooking a pleasant view of the river and surrounding lands. Some goods and services have value even though people are not aware that they are using the basin's resources, as when wetlands and soils remove undesirable substances from ground water and vegetation removes them from the air.

Sometimes people place a value on a good or service even though they do not use the resources or intend to use them. These so-called non-use values materialize, for example, when people want to maintain for future generations the existence of species threatened with extinction, or to maintain a particular characteristic of a resource that they believe has cultural or ecological significance.

Today, the Columbia Basin’s ability to provide water for irrigation and hydroelectricity is clearly important. Other valuable goods and services have long been associated with salmon and steelhead. These fish have been an important food for local residents, became products exported outside the basin, generated jobs and income, and constituted a central cultural, spiritual, and economic component of life within the basin’s tribal communities. The fish also have been linked (Cederholm et al. 2000) to the ecosystem’s ability to produce many other species and related goods and services. In a review of studies of the economic value the region has lost because of declines in fish populations, Corum (1987) concluded that, over the period 1960–1980, the aggregate loss associated with just commercial and recreational fishing was about $6.5 billion, expressed in 1980 dollars. This estimate does not include losses in the cultural, spiritual, and other non-use values incurred by members of the basin’s tribes and by others, or the losses in values associated with the ecosystem’s ability to produce other species and related goods and services.

The Management Program will affect socioeconomic conditions in the state insofar as it alters the supply and, hence, the value of individual goods and services, or if it affects the amount of money in the state’s economy. An increase will be a benefit for the economy, while a decrease will be a cost.

Table 3-21. Functions, Goods, and Services of Water-Related Ecosystem

Functions	Examples of Goods and Services Produced
Production and regulation of water	Natural and human-built features capture precipitation; filter, retain, and store water; regulate levels and timing of runoff.
Formation and retention of soil	Wetlands and biota accumulate organic matter, and prevent erosion to help maintain productivity of soils.
Regulation of atmosphere and climate	Biota produce oxygen, and help maintain good air quality and a favorable climate.
Regulation of disturbances	Wetlands and reservoirs reduce flood damage by storing flood waters, and reducing and slowing flooding.
Regulation of nutrients and pollution	Wetlands improve water quality by trapping pollutants before they reach streams and aquifers.
Provision of habitat	Streams and reservoirs provide habitat for fish and wildlife.
Food production	Biota convert solar energy into edible plants and animals.
Production of raw materials	Streams possess energy convertible to electricity.
Pollination	Insects facilitate pollination of wild plants and agricultural crops.
Biological control	Birds, bats, and microorganisms control pests and diseases.
Production of genetic and medicinal resources	Genetic material in wild plants and animals provides potential basis for drugs and pharmaceuticals.
Production of ornamental resources	Products from plants and animals provide materials for handicraft, jewelry, worship, decoration, and souvenirs.
Production of aesthetic resources	Wetlands, riparian vegetation, streams, and reservoirs provide basis for enjoyment of scenery.
Production of recreational resources	Streams, reservoirs, riparian vegetation, fish, and wildlife provide basis for outdoor sports, eco-tourism, etc.

Functions	Examples of Goods and Services Produced
Production of spiritual, historic, and cultural resources	Wetlands, riparian vegetation, streams, and reservoirs serve as basis for spiritual renewal, folklore, group identity, etc.
Production of scientific and educational resources	Wetlands, riparian vegetation, streams, and reservoirs provide inputs for research and focus for on-site education.

3.8.1.2 Jobs and Incomes

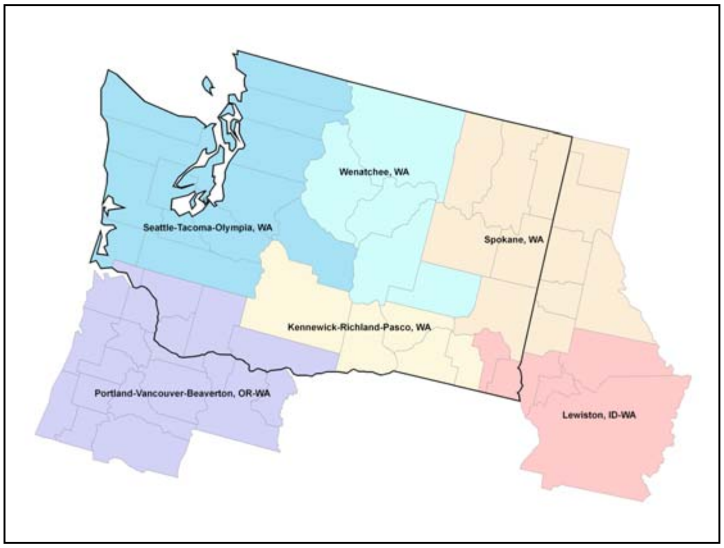
Water and related resources influence jobs and incomes through three mechanisms: providing goods and services that are inputs to commercial activities; producing goods and services that create a quality of life that influences household-location decisions; and providing other valuable ecosystem goods and services.

Commercial impacts materialize in the context of the state's six distinct regional markets for labor and local commerce, shown in Figure 3-14. Although municipal-industrial and other commercial uses of water are important, agriculture is the largest commercial user. However, Figures 3-15 and 3-16 show that agriculture's share of jobs and personal income has been declining for several decades, but less so in the Wenatchee and Tri-Cities regions. Expansion of irrigation historically has boosted the acreage and hence the jobs and income associated with small grain and forage crops, but generated little increase in the acreage of higher valued crops, because new acreage has displaced existing acreage of these crops (Hamilton et al. 1991).

Quality-of-life impacts materialize when amenities, such as water-related recreational opportunities, induce households to live nearby, and businesses expand to take advantage of the resulting increases in labor supply and consumer buying. Quality-of-life impacts have become more important in recent decades and now account for about one-half the interstate variation in job growth (Partridge and Rickman 2003).

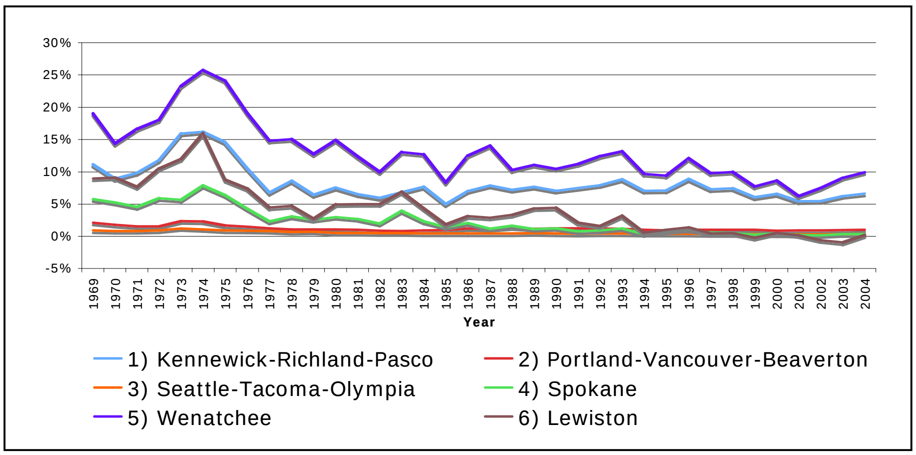
Radke and Davis (1995) estimated that if the Columbia Basin's populations of salmon and steelhead were at levels that existed prior to the development of dams and other activities that have had adverse effects, commercial and recreational fishing, plus related activities, would support 13,000–25,000 jobs and generate $254 million–$507 million of personal income annually, expressed in 1994 dollars. This estimate does not reflect jobs, incomes, and values associated with salmon-related recreational activities other than fishing, other salmon-related amenities that affect economic activity, salmon-related obligations to the basin's tribes, or resources other than salmon. Some water-related goods and services can influence jobs and incomes even though they are not direct inputs for commerce or amenities for households. Wetlands and floodplains, for example, can influence the risk of flood damage to downstream communities (Daily 1997).

Figure 3-14. Agriculture's Role in Washington's Regional Economies
Washington's Economic Regions



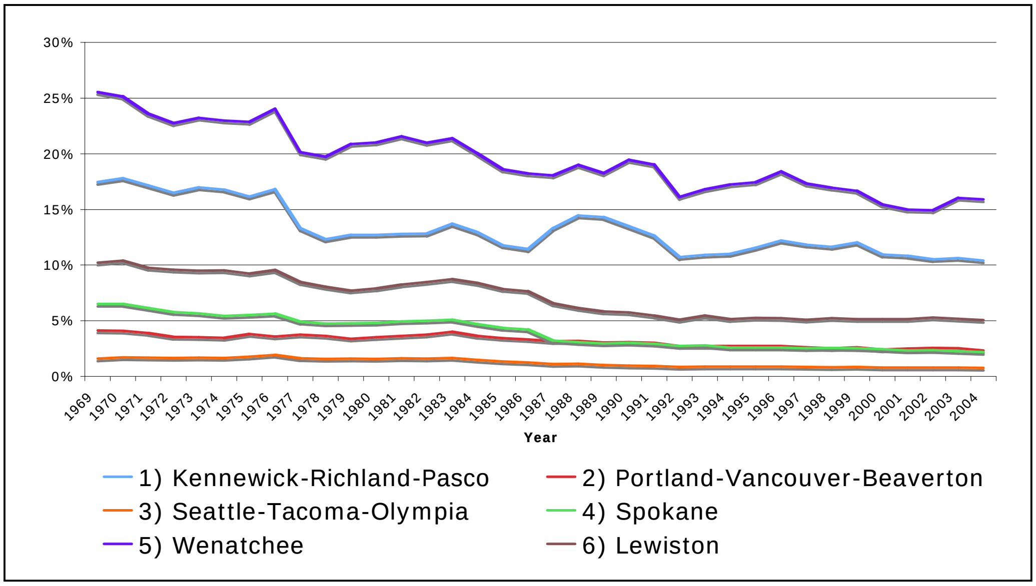
Source: Johnson and Kort (2004); Bureau of Economic Analysis (2006)

Figure 3-15. Farm Income as Percent of Total



Source: Johnson and Kort (2004); Bureau of Economic Analysis (2006)

Figure 3-16. Farm Employment as Percent of Total



Source: Johnson and Kort (2004); Bureau of Economic Analysis (2006)

Distribution of Costs and Benefits

The costs and benefits of water management decisions are sometimes not distributed equally among different groups. Decisions affecting salmon and steelhead, for example, can have important distributional effects governed by treaties, laws, and regulations (Independent Economic Analysis Board 2005). Also important is the unequal distribution resulting whenever those who enjoy the benefits of a good or service do not bear the full costs of its production. This outcome, which can arise from subsidies, the emission of pollutants, and other factors, increases jobs, incomes, and economic well-being for those who enjoy the benefits, and has negative effects on those who bear the costs. It also encourages the beneficiaries to consume the goods and services beyond optimal levels (Corps 1991).

Irrigators in the Columbia Basin receive subsidies as they fail to bear the full costs they impose on the overall economy when they divert water from streams and deliver polluted return flows to streams. Additional subsidies occur as irrigators use water without incurring the costs associated with these uses. Ortolano et al. (2000) estimated the subsidies that arise as irrigators in the Columbia Basin Project avoid paying the full costs of the intake structures, canals, pumps and other infrastructure that gather and deliver water to their fields, as well as the costs when diverted water is not available to generate hydroelectricity. They found the total to be at least $39 million, or about $17,000 per farm family, per year. Additional subsidies exist as irrigation activities adversely affect fish populations and the supply of other goods and services. In addition, many farms in the basin receive federal farm subsidies as well as subsidies for conservation of farm land. The Environmental Working Group (2006) has compiled federal data showing that federal subsidies of more than $2 billion were paid between 1995 and 2005 to farmers in 15 counties (Adams, Benton, Chelan, Columbia, Douglas, Ferry, Franklin, Grant, Kittitas, Klickitat, Lincoln, Okanogan, Stevens, Whitman, and Yakima). The extent to which these subsidies are associated with irrigated farm lands is not known.

Socioeconomic Structure

Water management affects and is affected by the socioeconomic structure along legal, financial, and other dimensions. An important element of this structure is the state's water rights system, which gives priority to the oldest uses and users (refer to Appendix D for a discussion of water rights in Washington state). Though this system generates some types of economic growth, it also can impede growth by resisting innovation and water reallocation (Huppert et al. 2004; National Research Council 2004). Federal guidelines limit use of federal funds for water resource projects that would benefit one region at the expense of another, with no net gain in the national economy (U.S. Water Resources Council 1983).

Uncertainty and Risk

Risk is the probability that a decision will generate an outcome less desirable than intended. Sometimes risk can be quantified, but often it remains uncertain. Uncertainty and risk are economically undesirable, and, all else equal, decisions that reduce them are preferred over those that do not. Farmers and other water users often take steps to reduce or compensate for the risk of water shortage. For example, in the Walla Walla Basin, Willis and Whittlesey (1998) found that farmers facing uncertainty over the amount of water crops require and the availability of future water supplies typically apply 28 percent more water than crops require, on average, to reduce the risk that crops will become stressed between irrigations.

Uncertainty and risk also can affect the value of other goods and services. An increase in uncertainty about the future viability of a species and the risk that it might go extinct, for example, typically leads to an increase in the value of incremental changes in the species' population. Similar increases in incremental value can accompany an increase in uncertainty and risk regarding the future supply of fish and other resources that tribes and other groups consider essential for sustaining their cultural identity.

3.8.2 Columbia Basin Specifics

Several recent studies describe some of the Columbia Basin's water-related socioeconomic conditions. These include an analysis of the Columbia River Initiative by economists from the University of Washington and Seattle University (Huppert et al. 2004) and a derivative analysis by an economist at Ecology (Zhang 2004). These analyses prompted two critiques (Griffin 2005; Williams and Capps, Jr. 2005). Another recent study examined a potential water shortage in the Odessa Basin (Bhattacharjee and Holland 2005). Two additional reports (Olsen and White 2004; Olsen 2006) generally address the economics of water and water rights in the basin, and another report (Resource Dimensions 2006) examines the likelihood that different levels of fees paid to the state in return for new water diversions will yield sufficient funds for the state to purchase water to meet instream flow requirements during future droughts.

Other literature helps define the appropriate perspective for examining socioeconomic conditions in the basin (Griffin 2006; National Research Council 2005; U.S. Water Resources Council 1983). This perspective emphasizes describing the incremental, or marginal, changes in the economy attributable solely to the Management Program, taking into account the economy's adaptive response to it.

3.8.2.1 Value of Goods and Services

The Columbia Basin's water and related resources produce many goods and services, but there exists no accounting of their overall value. Economists have, however, estimated the overall value of irrigation and the value of marginal (incremental) changes in the supply for irrigation and a few other goods and services. Table 3-22 shows, by major crop, the current acreage and the average per-acre irrigation, gross economic return, and net economic return (revenues minus production costs). Net economic return ranges from negative $12 for hay to positive $464 for potatoes (Huppert et al. 2004). Table 3-23 shows the net economic return per acre-foot of water diverted for irrigation ranges from negative $91 to positive $147 per acre-foot, depending on crop, for the basin as a whole, and from negative $82 to positive $129 within the Columbia Basin Project (Huppert et al. 2004). For hay, wheat, and "other crops", the production cost exceeds the gross value of the crop and the net return is negative. Farmers continue to grow these crops, though, because from a cash-accounting basis, they are able to overlook some costs, such as the costs of using equipment and property that have already been paid for (Huppert et al. 2004).

Table 3-22. Estimated Acreage, Average per-Acre Irrigation, and Local Economic Returns, by Crop

	Hay	Orchards	Vegetables	Other	Potatoes	Wheat
Acres	319,707	200,689	141,939	195,934	159,100	224,668
Irrigation (acre-feet)	4.43	3.53	2.59	2.82	2.97	2.77
Gross economic return per acre	$877	$5,485	$1,408	$961	$3,122	$344
Net economic return per acre	-$25	$312	$276	-$271	$464	-$99

Source: Huppert et al. 2004

Table 3-23. Estimated Average Net Economic Return per Acre-Foot of Water Diverted

	Hay	Orchards	Vegetables	Other	Potatoes	Wheat
Entire region	-$5	$82	$89	-$91	$147	-$34
Columbia Basin Project	-$5	$67	$96	-$82	$129	-$29

Source: Huppert et al. 2004

Table 3-24 shows recent estimates of the marginal value of some water-related goods and services. The top portion focuses on irrigation. Ecology has estimated the cost of developing new water sources (728,000 acre-feet) at $17 per acre-foot (Zhang 2004). To the extent that Washingtonians provide the money, then the development would impose a cost on the state's economy. However, if residents of other states provide the money, their contributions would benefit the economy. Taking into account only the local effects, and assuming marginal changes will have the same characteristics as current averages, the value of marginal changes in irrigation water ranges from negative $91 to positive $147 per acre-foot for the basin as a whole, and from negative $82 to positive $129 within the Columbia Basin Project (Huppert et al. 2004).

Table 3-24. Estimates of Marginal Value of Selected Water-Related Variables

Variable	Marginal Value	Source
Development cost of new water	($17/ac-ft)	Zhang (2004)
Water for irrigation, local perspective		
Entire basin	($91) – $147/ac-ft	Huppert et al. (2004)
Columbia Basin Project	($82) – 129/ac-ft	Huppert et al. (2004)
Water for irrigation, state perspective	($60) – ($70)/ac-ft	Williams and Capps, Jr. (2005)
Water for municipal-industrial use	$65 – $452/ac-ft	Zhang (2004)
Water for hydropower (Lake Roosevelt downstream)	$37.39/ac-ft	Huppert et al. (2004)
Water for hydropower (Wells Dam downstream)	$15.65/ac-ft	Huppert et al. (2004)
Water for hydropower (McNary Dam downstream)	$7.46/ac-ft	Huppert et al. (2004)
Water for navigation	$5.60/ac-ft	NRC (2004)
Water for general recreation	$7.70 – $130/ac-ft	NRC (2004)
Water for waste assimilation	$0.20–$0.28/ac-ft	NRC (2004)
Water for ecosystem functions	$21	Brown (2004)
Salmon & steelhead population	$715/fish	Huppert et al. (2004)
Sediment pollution in streams	($12)/ton	Ribaudo (1989); Pimentel et al. (1995)
Nitrogen pollution in streams	($1,930) – ($16,000)/ton	Hey et al (2005)
Phosphorus pollution in streams	($1,830) – ($3,400)/ton	Hey et al. (2005)

These values account only for the direct effects on irrigators who would benefit from an increased supply of water, assuming that any increase in supply of irrigated crops would have no impact on the overall market. Williams and Capps Jr. (2005) relaxed this assumption and considered the likelihood that, all else equal, for most crops an increase in supply would cause prices to fall. They concluded that the increase in the supply of irrigation water examined by Huppert et al. (2004) would be large enough to cause the prices of most irrigated crops to decline significantly. As a consequence, the earnings of existing producers of irrigated crops would fall below what they would be without the increase in irrigation. They further concluded that the increase in irrigation would result in a negative effect on the earnings of farmers as a whole: the overall impact on farmers' earnings would be between negative $60 and negative $70 per acre-foot of additional irrigation water. These findings do not necessarily contradict the findings of Huppert et al. (2004), who acknowledged the importance of, but did not calculate, the downward pressure that an increase in irrigation supplies would exert on prices and farmers' overall earnings. Negative price effects have been seen previously, for example, between 1997 and 2002, when irrigated acreage in Washington increased 20 percent but the value of the crops grown on these acres grew only 4 percent (Wines no date) or, when adjusted for inflation, decreased.

Olsen (2006) says several "problems/issues" in the analysis by Williams and Capps Jr. (2005) affect their conclusions, but he provides little or no support for this assertion. For example, he asserts that any increase in the supply of water for irrigation would "be primarily used for high value crops" but provides no supporting data and does not address, let alone disprove, the contrary evidence provided by Williams and Capps Jr. (2005).

The middle rows of Table 3-24 show the estimated, marginal value per acre-foot of water for municipal-industrial use, hydropower, navigation, general recreation, waste assimilation, and ecosystem functions. The estimate for municipal-industrial use exceeds the others. The hydropower values represent all the electricity that would be generated at all dams downstream from the indicated point on the Columbia River. The estimates for navigation, recreation, and waste assimilation are typical for the region and are not site-specific. The estimate for ecosystem functions represents the marginal value of water protected or acquired for environmental purposes on national forest lands in the Pacific Northwest.

The bottom of Table 3-24 shows estimates of marginal values for fish populations and pollution. The marginal value of salmon and steelhead has been estimated to be $715 per fish, reflecting Washingtonians’ current willingness to pay to diminish the risk of extinction and to restore healthy fish populations. This estimate updates smaller values reported earlier by Olsen and White (2004). The marginal value is not fixed. It probably would rise (or fall) in the future with increases (or decreases) in the state’s human population, for example, or with decreases (or increases) in fish populations. The marginal value does not represent the aggregate value of existing fish populations, past reductions in fish populations, or greater-than-marginal future changes in fish populations. In a presentation to the committee that produced Huppert et al. (2004), Olsen and White (2004) stated that, with water levels equal or above the average of recent years, a marginal change in instream flow would be too small, relative to total flow, to have a perceptible impact on fish populations and, hence, the fish-related impact would have zero economic value.

Pollutants in streams and rivers have a negative value. Agriculture and some urban-industrial areas in the basin contribute heat energy, sediment, nutrients, pesticides, and pharmaceuticals into the basin’s water supplies (National Research Council 2004; Ribaudo and Johansson 2006). Estimates of marginal value are available only for sediment, nitrogen, and phosphorus in streams. The estimate for sediment reflects the on-site loss of agricultural soil productivity and some off-site damages, such as costs to clean clogged stream channels, but not the costs of impacts on salmon and other environmental impacts. The estimates for nitrogen and phosphorus, derived in the Midwest, reflect the cost of removing these pollutants from streams using either wetlands and riparian forests (less expensive) or treatment plants (more expensive).

Incremental changes in water use in the basin might affect the value of goods and services beyond just those shown in Table 3-25. Increases in agricultural, municipal, and industrial uses, for example, might result in increased emission of pollutants (including total dissolved gases) that would diminish water quality downstream, and increases in hydropower generation might increase the mortality of young salmon. A possible overall effect is that water temperatures could be adversely impacted. Decreases in these uses might have the opposite effects. The estimates in Table 3-25 of the marginal values associated with different water uses do not reflect these spillover effects, or environmental externalities. Externalities are economic consequences of one’s actions that accrue to somebody else. This omission does not mean the externalities do not exist, only that economists have not estimated them.

Table 3-25. Estimated Statewide Employment per 1,000,000 Acre-Feet Diverted in the Columbia River Basin (Huppert et al. 2004)

	Employment	
	Direct	Total
Agriculture	18,420	44,841
Hydropower, statewide	- -	154 – 205

3.8.2.2 Jobs and Incomes

The basin's water and related resources affect jobs and income when they are used commercially, influence household-location decisions, and provide environmental services that influence the cost of living and working in the area. Commercial effects arise primarily from agricultural use of water. Table 3-25 shows a recent estimate by Huppert et al. of the employment created from the diversion of 1 million acre-feet (Huppert et al. 2004). Employment in industries (field and seed crops, vegetables and fruit, canning and preserving, grain milling, and beverages) directly involved in producing and processing irrigated crops totals 18,420 jobs. Additional employment is generated through the multiplier effect, as the purchases of farms and farm workers generate jobs in other industries, for example, and raises the total to 44,841. Insofar as the diversion of water for irrigation reduces the amount of water available to generate hydropower, it reduces statewide hydropower-related employment by 154 – 205 jobs.

Water used for other purposes, such as recreation and commercial fishing, also affects jobs, but these impacts have not been estimated, even though their contribution to the local and regional economy is far from negligible. The 2002 agricultural census, for example, found that farms and ranches in Washington produced crops and livestock with a commercial net value, exclusive of government subsidies, of about $5.3 billion (USDA 2004). In comparison, a 2001 survey found that the resources supporting fishing, hunting, and wildlife-watching activities in the state had a value of about $2.2 billion (USFWS and U.S. Census 2003). The U.S. Forest Service (Haynes and Horne 1997) has estimated that the average, net economic value of fishing on federal lands in eastern Washington was $1.22 – $6.58 per acre, in 1994 dollars. The study also estimated per-acre values for other resource-related, recreational activities on federal lands in Eastern Washington: hunting ($3.22 – $1.47); viewing wildlife ($0.32 – $0.60); day use ($0.68 – $4.20); trail use ($0.48 – $9.28); viewing natural resources from a motor vehicle ($0.19 – $5.09); motor boating ($0.04 – $0.02); and non-motor boating ($0.05 – $0.07). The same study stated that, between 1991 and 1993, recreation activities supported 18,640 jobs in the Tri-Cities area, of which 45 jobs were related to fishing, 145 to hunting, 9 to viewing wildlife, 70 to day-use recreation, 50 to trail use, 190 to viewing natural resources from a motor vehicle, 15 to motor boating, and 7 to non-motor boating.

Water-related and other natural resource amenities appear to affect the location decisions of some households in the basin (McGranahan 1999) but their influence on jobs and incomes has not been quantified. Similarly, the basin's water-related ecosystem provides services, such as absorbing and removing impurities from water and mitigating flooding, that affect the cost of living and working in the basin, but their effects have not been quantified (National Research Council 2004).

3.8.2.3 Distribution of Costs and Benefits

There are pervasive opportunities for one individual, business, or group to enjoy economic benefits derived from the basin's water and related resources with some or all of the costs falling on others. These opportunities arise, in large part, because these resources are not managed through mechanisms comparable to those that exist in markets (National Research Council 2004; Houston et al. 2002). Hence, recreationists, irrigators, commercial fishers, households, municipalities, electric utilities, barge owners, and industries can use water without having to pay the equivalent of a market price for what they use. Activities that produce agricultural, hydropower, or other benefits but degrade habitat for salmon and habitat can impose costs on anglers and commercial fishers, in the basin and throughout the northeast Pacific region, and on individuals who place a non-use value on the species and may live locally or far away (Fluharty 2000; National Research Council 2004). Conversely, persons successful in constraining activities harmful to fish can enjoy the benefits of their success without compensating those whose activities are constrained. Irrigators and others can enjoy the benefits of water extracted from a constrained aquifer without compensating others, including future generations, who would use it.

Economists have recommended further development of markets or market-like institutions to manage water and related resource in the basin, but to date there has been little progress (Fluharty 2000; Houston et al. 2002; National Research Council 2004). Environmental regulations and voluntary actions sometimes have the effect of bringing the costs of water uses closer to the benefits, as when irrigators, municipalities, and industries incur the costs of reducing their water use and their emissions of pollutants to water bodies. Significant opportunities for conserving water and protecting water quality go unrealized, however, even when the benefits to a water user of seizing such an opportunity would more than compensate for the costs. Schaible (2000), for example, found that irrigators in the Pacific Northwest (Idaho, Washington, and Oregon) have not taken steps toward conservation that would reduce water diversions by 1.7 million acre-feet per year, even though economic analysis indicates that taking these steps would generate substantial net economic benefits or minimal net costs. Several factors slow the pace of conservation: many believe water laws force them to use the water to which they are entitled or lose the entitlement; they would lose control over any conserved water and hence, the benefits would accrue to and benefit others; they lack sufficient financial resources and/or would incur significant financial risk to implement conservation measures; and the cost of resolving uncertainty surrounding conservation is too high to overcome (National Research Council 2004; Schaible 2000).

3.8.2.4 Socioeconomic Structure

Many aspects of economic activity and social organization in the basin have long been tied directly to water. Harvest of salmon and steelhead has provided a cultural focus and the basis for much economic activity for the members of tribal groups, non-tribal commercial fisheries, and recreational fisheries (Fluharty 2000). Irrigation has enabled the expansion of agriculture, and hydropower has enabled the flow of electricity to homes and businesses throughout the western states. Water for municipal and industrial uses supports urban development. The federal government plays a dominant role in managing the river, the state oversees management of water rights, local utilities and irrigation districts manage water within their control, and tribes exercise their treaty rights over some river resources.

3.8.2.5 Risk and Uncertainty

Major concerns about risk and uncertainty have been expressed regarding habitat for salmon and steelhead, especially during critical times and conditions, and for irrigators, especially during times of drought for those who have invested in orchards and other perennial crops (Huppert et al. 2004; National Research Council 2004). Withdrawals of surface water increase the risk to salmon and steelhead, but the levels of risk are understood only in broad, qualitative terms and, hence, water management decisions in the basin necessarily must be made in the face of uncertainties. To avoid risks to salmon and steelhead that are unacceptable within the current regulatory climate, if additional withdrawals are allowed they should be terminated during periods when habitat conditions are critical for fish conservation (National Research Council 2004). Refer to Section 3.7 for a discussion of the effects of water management on fisheries.

Resource Dimensions (2006) examined the likelihood that potential fees paid to the state in return for permission to withdraw additional surface water for irrigation and other uses would yield sufficient funds for the state to secure water to increase stream flows during future drought years. The authors concluded that several uncertainties and risks would affect the sufficiency of the accumulated funds. Among the most important are the length of time funds accumulate before a drought occurs, the duration and intensity of future droughts, the extent to which water would be available during future droughts for the state to acquire, and the management of the accumulated funds. Given these uncertainties and risks, the authors recommend charging a fee of $30 per acre-foot until there is sufficient evidence indicating that a lower fee would provide funds to secure sufficient water for instream flow during future droughts. They also recommended that the state commit to supplement the accumulated funds if they prove insufficient to mitigate future droughts.

Farmers and state agencies have demonstrated an extensive ability to adapt to drought. Farmers leave land fallow, shift water from low- to high-value crops, and obtain water from emergency sources, such as new wells. Ecology and other agencies can lower minimum streamflow requirements, allow emergency wells, and lease water from irrigators to increase streamflows. In the 2001 drought, 330 farmers in the Columbia Basin had to curtail water use. Apple and potato production declined 10 percent and 2 percent, but prices rose 42 percent and 38 percent, and total value rose 20 percent and 24 percent, respectively (Washington State Department of Community, Trade and Economic Development et al. 2005).

3.8.3 Early Action Study Areas

Until the 1960s, farming in the Odessa area involved dryland production of wheat. Since then farmers have irrigated 170,000 acres with ground water from deep wells, but withdrawals have caused the water level to decline and future declines may render irrigation infeasible (Bhattacharjee and Holland 2005). Concern has been expressed especially for the future production of potatoes, among the most water-intensive crops, on 36,000 acres with an annual yield of about 21 million hundredweight, worth about $100 million (Bhattacharjee and Holland 2005) or about 20 to 25 percent of the statewide total.

3.9 Land and Shoreline Use

Land use in the project area is highly diverse. Portions of the Cascade Mountains are federally owned wilderness areas, national parks, national recreation areas, and national forests. The national forests are managed for multiple uses, including commercial timber production and recreation. Private forest lands are also common in these mountainous areas as well as in northeastern Washington.

Areas around Spokane, Richland, Kennewick, Pasco, Yakima, and Wenatchee in eastern Washington, and around Vancouver in southern Washington, are characterized by urban levels of development. These urbanized areas host much of the project area's population, as well as its manufacturing, commercial, and service industry base.

The project area also contains extensive agricultural development, especially in eastern Washington. The Yakima, Wenatchee, and Okanogan River valleys and the central Columbia River Basin include large-scale irrigated agriculture. Southeastern Washington is extensively developed for dry-land farming, primarily wheat.

In the portions of the project area north and east of Lake Roosevelt, in the Cascade Mountains, and west of the Cascades to the mouth of the Columbia River, the predominant land use is forest, ranging from 53 to 91 percent of the land area. In the central portion of the project area—the area most likely to be affected by the Management Program—the predominant land uses are agriculture and rangeland. Agricultural uses in the central portion of the project area range from 30 to 73 percent of the land area, and rangelands comprise from 26 to 80 percent of the land area. Urban uses are only significant in and around Vancouver (WRIA 28) and Spokane (WRIA 57), where urban uses account for approximately 23 percent of land area. Additional information on land use in the project area can be found in Table 4-2 of the Final EIS for Watershed Planning (Ecology 2003b).

3.9.1 Future Land Use

Counties and cities that have experienced significant growth over the last several decades are required to prepare comprehensive plans under the state's Growth Management Act (GMA) (Chapter 36.70A RCW). The GMA requires affected cities and counties to designate their rural areas and urban growth areas and to conduct capital facilities planning to ensure that adequate public facilities are provided concurrent with future growth within designated urban growth areas. The GMA also requires that all counties and cities develop and adopt development regulations to protect environmentally critical areas such as wetlands, fish and wildlife habitat, and aquifer recharge areas. Regulations must also be adopted to protect natural resource lands, which include agricultural, forest, and mineral resource lands. Figure 3-17 shows counties that are required to fully plan under GMA and major urban growth boundaries in the Management Program project area.

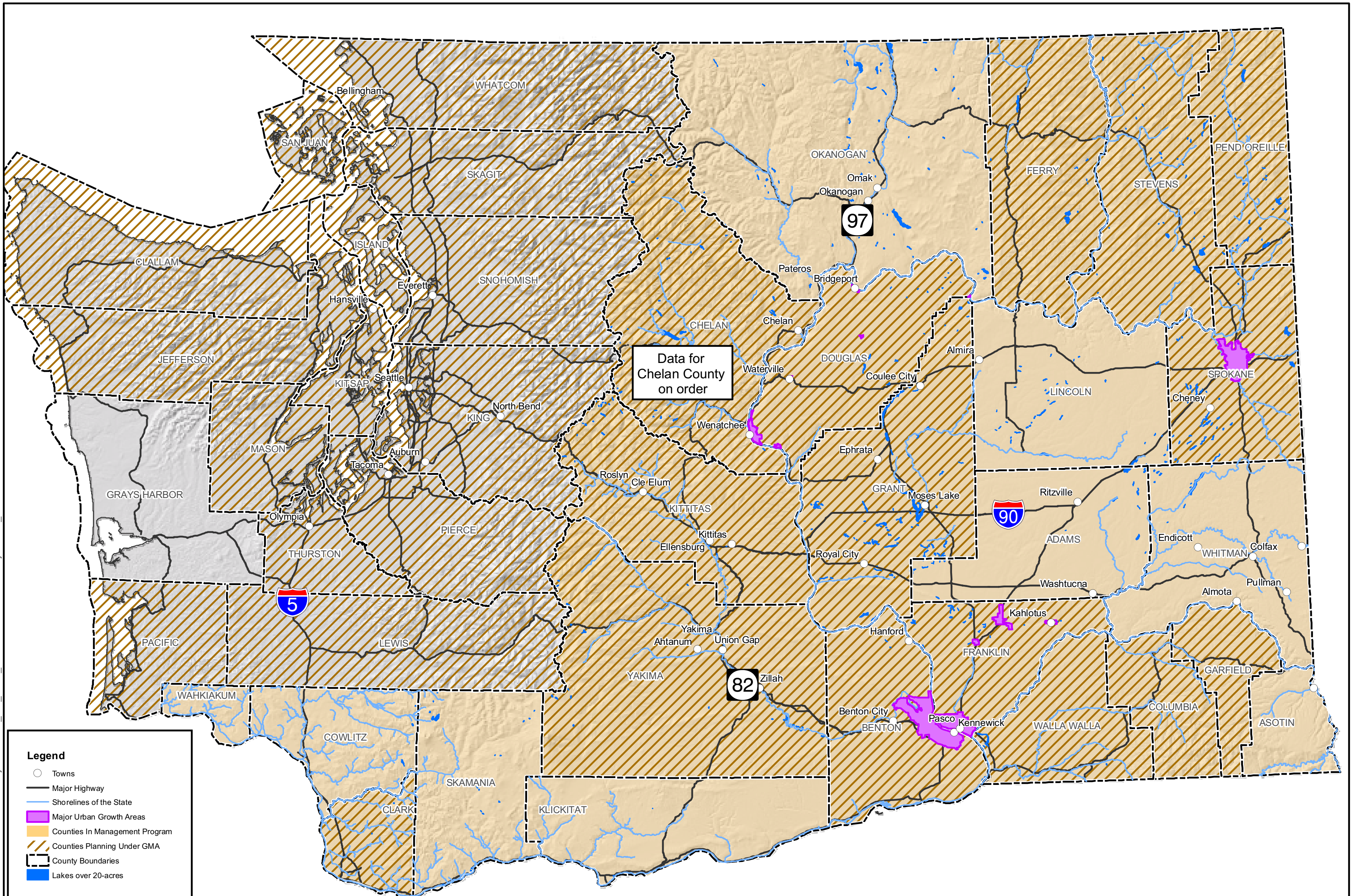


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FIGURE 3-17

COUNTIES PLANNING UNDER GMA AND SHORELINES OF THE STATE

COLUMBIA RIVER WATER MANAGEMENT PROGRAM EIS

WASHINGTON

Of the 25 counties in the Management Program project area, the 19 that are located in eastern Washington are most dependent on the water supplies that could be affected by the Management Program. The total population of the 19 counties in the project area in eastern Washington was estimated to be approximately 1.38 million people in 2006 (OFM 2006). Two of the four fastest-growing counties in the state, in terms of percent change since the 2000 U.S. Census, are in the Management Program project area in eastern Washington: Franklin County (22.6 percent) and Benton County (11.0 percent) (OFM 2005). Six counties in eastern Washington have already exceeded the estimated low end of the range for population growth through 2025. The total population of the project area's 19 counties in eastern Washington is projected to grow to between 1.45 and 2.01 million people by 2025 (OFM 2002). Most of this growth is expected to occur in within counties planning under GMA, and is planned to occur within urban growth areas.

3.9.2 Shorelines

Many of the activities that would occur under the Management Program would be located within shorelines of the state. These areas are governed under shoreline master programs developed under the authority of the state's Shoreline Management Act (Chapter 90.58 RCW). "Shorelines of the state" are the total of all "shorelines" and "shorelines of statewide significance" within the state (RCW 90.58.030(2)c.)

"Shorelines" is defined in the Shoreline Management Act as:

> *…all of the water areas of the state, including reservoirs, and their associated shorelands, together with the lands underlying them; except (i) shorelines of statewide significance; (ii) shorelines on segments of streams upstream of a point where the mean annual flow is twenty cubic feet per second or less and the wetlands associated with such upstream segments; and (iii) shorelines on lakes less than twenty acres in size and wetlands associated with such small lakes;…* (RCW 90.58.030(2)d.)

"Shorelines of statewide significance" within the Management Program project area include the following water bodies and the land within 200 feet of the ordinary high water mark:

> *Those lakes, whether natural, artificial, or a combination thereof, with a surface acreage of one thousand acres or more measured at the ordinary high water mark;*
>
> *Those natural rivers or segments thereof as follows:*
>
> *Any west of the crest of the Cascade range downstream of a point where the mean annual flow is measured at one thousand cubic feet per second or more,*
>
> *Any east of the crest of the Cascade range downstream of a point where the annual flow is measured at two hundred cubic feet per second or more, or those portions of rivers east of the crest of the Cascade range downstream from the first three hundred square miles of drainage area, whichever is longer;…* (RCW 90.58.030(2)e)

Local shoreline master programs, which must be approved by Ecology, are intended to protect shoreline ecology, public access, and water-dependent uses and to require mitigation of impacts where appropriate.

3.9.3 Tribal and Federal Lands

Substantial portions of the Management Program project area are reserved under treaties with Native American tribes. These areas of the state are not subject to the GMA and Shoreline Management Act. Each tribe or confederation of tribes enacts its own laws to control land use and protect natural resources on lands within the reservation.

The federal government controls and manages a substantial area of land in the Management Program project area, including forests, rangeland, national parks, the Hanford Nuclear Reservation, the Hanford National Monument, and other lands. Federal activities on these lands are not subject to the local regulations or the Shoreline Management Act, but federal policies generally direct that activities of the federal government should be consistent with local regulations to the extent feasible within the mission of each agency.

3.9.4 Early Action Study Areas

3.9.4.1 Lake Roosevelt Drawdowns

Land Use Near Lake Roosevelt

Lake Roosevelt is approximately 140 miles long and is nearly surrounded by the Lake Roosevelt National Recreation Area (NRA) (Figure 2-3). Under the 1990 *Lake Roosevelt Cooperative Management Agreement*, the lake is jointly managed by the Bureau of Reclamation (Reclamation), National Park Service (NPS), Bureau of Indian Affairs (BIA), Confederated Tribes of the Colville Reservation (Colville Tribes), and Spokane Tribe. The NPS manages 312 acres of shoreline, 47,438 acres of the 81,389-acre water surface, and 12,936 acres of land within the NRA. With the exception of waters surrounding Grand Coulee Dam, which are overseen by Reclamation, the NRA's remaining water surface is contained within the Reservation Zone and managed by the Colville Tribes and Spokane Tribe. A substantial portion of Lake Roosevelt is within the boundaries of the Spokane and Colville Reservations.

The Colville Tribes oversee much of the NRA's western shoreline and waters, which are adjacent to the 1.4-million-acre Colville Reservation. The Spokane Tribe oversees waters and shorelines near the Spokane River's confluence with Lake Roosevelt, which are adjacent to the 157,376-acre Spokane Indian Reservation. Within the Reservation Zone, the Colville and Spokane Tribes "retain the right to beneficially develop and utilize the natural resources and to develop economic enterprises that are compatible within the character of the (Management Area), subject to federal statutory requirements" (Lake Roosevelt Cooperative Management Agreement 1990). The Tribes generally manage the area for hunting, fishing, forestry, and other natural resource-oriented purposes. In particular, the Colville Tribes retain the right to fish throughout Lake Roosevelt, and the Spokane Tribe retains the right to fish in Lake Roosevelt waters abutting the Spokane Reservation. Some irrigated agriculture lands are adjacent to the recreation area (Cassidy 1997a).

Title 16 of the United States Code Subchapter One directs the NPS to:

> *Promote and regulate the use of the Federal areas known as national parks, monuments, and reservations* (later amended to include all units of the NPS), *which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.*

Within the Lake Roosevelt NRA, the NPS manages 22 boat launch ramp areas, 27 campgrounds, and three concessionaire-operated marinas that provide moorage, boat rental, fuel, supplies, and other services to the public. Visitation to the NRA has been between 1.3 and 1.5 million for the last several years. Parts of the NRA have been managed for grazing since 2001, and a prescribed fire program is being developed for the fire-dependent (seral) ponderosa pine forests in the area.

Land Use in Areas to Receive Additional Water from Lake Roosevelt Drawdowns

Lands that could receive additional water from the Lake Roosevelt drawdowns fall into two major categories: lands to receive water in non-drought years, and lands to receive water in drought years. In non-drought years, municipal and industrial lands in the Columbia Basin Project area and lands within the Odessa Subarea could receive additional water.

Municipal and industrial uses that could receive additional water for use in non-drought years would be located in the Columbia Basin Project area. The Columbia Basin Project area is located east of the Columbia River in an area dominated by agricultural uses, with a number of small municipalities including Moses Lake, Ephrata, Othello, Quincy, and Ritzville (see Figure 2-2). Municipal and industrial users who would benefit from this new water supply would most likely be within existing cities and towns but could also include new uses outside of these areas. The Odessa Subarea is primarily agricultural, and lands that would receive water from the drawdowns in this subarea are existing irrigated farmland.

During drought years, land along the Columbia River with interruptible water rights could receive additional water. Water users on the Columbia River who have interruptible water rights include agricultural, residential, and industrial users. These users are located within one mile of the mainstem of the river, primarily in the central Columbia River Basin. Depending on the definition adopted for the mainstem Columbia River, this could also include a one-mile distance from the backwater areas on tributaries of the river as well (see Section 6.1.10 for additional information).

3.9.4.2 Supplemental Feed Route

Upper Crab Creek is in the area north and east of Moses Lake (Figure 2-1). Land use along Upper Crab Creek is primarily pastureland and publicly owned arid steppe lands managed for wildlife. The area around Brook Lake includes a few homes and commercial orchards. Limited areas of irrigated farmland are adjacent to the stream north of the City of Moses Lake and downstream from Brook Lake. Low-density urban residential development is near the stream as it approaches and enters the City of Moses Lake.

Land use along the existing portion of the W20 Canal is primarily irrigated farmland. The area where the W20 Canal would be extended is primarily grassland.

Land use along the Frenchman Hills Wasteway is primarily irrigated farmland. There is a small area of urban residential development adjacent to the canal in the town of Quincy, and the area near the mouth of the canal at Potholes Reservoir is arid steppe land managed as a wildlife area and as a state park. The Potholes Reservoir area is used for recreation, including camping, boating, and fishing.

Land use along the East Low Canal is a mixture of irrigated and non-irrigated farmland and arid steppe lands.

Land use in the Potholes Reservoir area includes irrigated farmland and arid steppe lands primarily managed for wildlife habitat, campgrounds, and boating facilities. The Moses Lake area includes urban uses and recreational uses along the lake, including residences and facilities for boating.

3.9.4.3 Columbia-Snake River Irrigators Association Voluntary Regional Agreement

The CSRIA represents farming operations in eastern Washington that irrigate about 250,000 acres of row crop, vineyard, and orchard lands. Their members have farming operations along the Columbia-Snake River system north from Brewster, reaching to the south along the John Day and McNary Pools**.** Some of the members own farming operations in the Yakima Valley and within the Columbia Basin Project area. The membership also includes several municipal service irrigators, including Brewster, Kennewick, West Richland, and the Kennewick Irrigation and Hospital Districts. Projects proposed for the CSRIA Voluntary Regional Agreement could participate in the program.

3.10 Cultural Resources

Because this is a programmatic EIS, the cultural resources overview of the large Management Program area is necessarily general. Some of the specific projects within the Management Program will require a more detailed cultural resource analysis at the project level. This section describes the legal framework for the protection of cultural resources and presents a general overview of the history and cultural resources of the area.

3.10.1 Legal Framework for Protection

Cultural resources are protected at both the state and federal level. Cultural resources are defined as buildings, objects, sites, or structures that are of historic, cultural, archaeological, scientific, and/or architectural significance.

Washington State Executive Order 05-05 establishes a review process by the Department of Archaeology and Historic Preservation (DAHP) and affected tribes for capital projects or land acquisition proposed by state agencies. Ecology has initiated the project review process for the Management Program with DAHP. Ecology may need to initiate the project review process in the future for specific projects proposed under the Management Program.