UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to:
OSB2001- 0153-FEC

August 10, 2001

Mr. Robert E. Willis
Chief, Environmental Resources Branch
Department of the Army
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Act Essential Fish Habitat Consultation for the City of Boardman, Collector Well No. 2 Project, Columbia River, River Mile 268.0, Morrow County, Oregon

Dear Mr. Willis:

Enclosed is a biological opinion (Opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act (ESA) on the effects of the proposed City of Boardman Collector Well No.2 Project in Morrow County, Oregon. In this opinion, NMFS concluded that the proposed action is not likely to jeopardize the continued existence of ESA-listed Snake, Columbia, and Willamette River salmon or steelhead, or destroy or adversely modify designated critical habitat. As required by section 7 of the ESA, NMFS included reasonable and prudent measures with nondiscretionary terms and conditions that NMFS believes are necessary to minimize the impact of incidental take associated with this action.

This Opinion also serves as consultation on Essential Fish Habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations at 50 CFR Part 600.

If you have any questions regarding this consultation, please contact Kate Vandemoer of my staff in the Oregon Habitat Branch at (503) 230-5422.

Sincerely,

Russell M Strach for

Donna Darm
Acting Regional Administrator

cc: Barry Beyeler - City of Boardman
Daryl Sunday - Sunday and Associates

Endangered Species Act Section 7 Consultation
and
Magnuson-Stevens Act
Essential Fish Habitat Consultation

Biological Opinion

City of Boardman
Collector Well No. 2 Project
Columbia River, River Mile 268.0
Morrow County, Oregon

Agency: U.S. Army Corps of Engineers, Portland District

Consultation Conducted By: National Marine Fisheries Service,
Northwest Region

Date Issued: August 10, 2001

Refer to: OSB2001-0153-FEC

TABLE OF CONTENTS

1. INTRODUCTION

The U.S. Army Corps of Engineers (Corps) proposes to authorize use of land leased to the City of Boardman (the City) for operation of a Ranney-type radial collector well identified as Collector Well No.2. The purpose of the well operation is to expand the City's primary source of water for residents and limited industrial use. The Corps is proposing to authorize the use pursuant to its authority under the Act of Congress dated December 22, 1944 (current version at 16 U.S.C. section 460d).

The action area for this consultation includes listed salmonid habitat that is affected by the proposed operation of Collector Well No.2 and encompasses designated critical habitats from the project location on the Columbia River at approximate River Mile 268.0 downstream to the Pacific Ocean.

1.1 Background

The existing water supply for the City's approximately 1500 residents and limited industrial users is provided by a single Ranney-type collector well located near the center of town on the shore of the reservoir created by the John Day Dam, about 50 miles downstream. A Ranney-type collector well operates hydraulically, similar to a vertical well, but has lateral well screens installed near the bottom of the central caisson and pump house. The lateral screens extend outward below the level of the river bed like spokes on a wheel so that more of the saturated thickness of the aquifer can be used. These lateral screens collect water as it is filtered through sand and gravel and direct it into the central caisson.

During the 1970's, the City acquired water rights and identified sites for the installation of two additional collector wells immediately west of the existing collector. No alternative sources of water have been identified for expansion of the present water supply. Construction of a new collector well at either of these sites would not directly affect waters of the United States and therefore would not require a permit from the Corps under either Section 10 of the Rivers and Harbors Act or Section 404 of the Clean Water Act. However, the land itself is under the Corps' direct control as part of the John Day Project. The Corps may authorize use of the land for a variety of public interest purposes, including water resource development projects, but must ensure that such actions are not likely to jeopardize the continued existence of any listed species or destroy or adversely modify the designated critical habitat of such species.

1.2 Consultation History

With the consent of the Corps, representatives of the City contacted the National Marine Fisheries Service (NMFS) during the summer of 1999 to begin informal consultation regarding the City's plan to improve its municipal water system. A succession of meetings and conversations between the City and NMFS followed regarding the likely adverse effects of a new collector well on listed species, and about ways to minimize or mitigate those effects.

By the fall of 2000, the City decided to expand participation in a flow replacement plan described in a biological opinion issued by NMFS in December 1998 (NMFS 1998a). In that opinion, NMFS found that the Corps' approval of a new irrigation withdrawal would have a "zero net impact" on instream flow objectives that were originally established for the benefit of Snake River salmon during the juvenile migration season because the applicant created a program to provide replacement flows.

The flow replacement plan operates by promoting voluntary changes in crop patterns and thus reducing water consumption on neighboring farms. The Benton Conservation District (BCD)[1] administers the plan. In February 2001, the BCD attributed irrigation reductions of 84,606 acre-inches per year to enrollment of 1,948 acres in the program[2], although that figure overestimates total flow replacement since it does not account for changes in consumptive use and return flows. BCD also calculated a reduction in soil erosion from those same acres of 32,650 tons per year. The City's intention is to extend participation in the plan to more farms as necessary to achieve additional water savings equivalent to the amount the City plans to pump from its new collector well.

The City completed construction of the new collector well, identified as Collector Well No. 2, in February 2001. The well consists of a 13-foot interior diameter caisson approximately 48-feet deep, equipped with seven stainless steel laterals, each 12-inches in diameter. The laterals range in length from 65 to 190-feet. Test-pumping of the well was completed in March, 2001.[3]

In a letter faxed to NMFS on April 11, 2001, the Corps requested formal consultation on the effects of operating the Collector Well No.2. The letter included a finding that operation "may affect, [and is] likely to adversely affect" listed salmon and steelhead because it is hydraulically connected to the Columbia River and thus would have a direct effect on instream flows. A biological assessment (BA) for the proposed action, prepared by Sunday & Associates and dated April 11, 2001, was also provided.

1.3 Proposed Action

The action proposed is the Corps of Engineer's issuance of a lease pursuant to the Act of Congress dated December 22, 1944 (current version at 16 U.S.C. section 460d) to authorize operation of the City's Collector Well No. 2 at a maximum rate of 22.57 cubic-feet per second (cfs), and completion of a flow replacement plan that will provide an equivalent amount of water while the instream flow objectives are in effect. As a condition of the Corps' lease, when fully carried out, the City's flow replacement plan will provide for instream use, at the point of the diversion or upstream of this point during periods when instream flow objectives are not likely to

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[1] Benton Conservation District is a State-mandated agency dedicated to agricultural conservation in Benton County, Washington, with offices located at 24106 North Bunn Road in Prosser, Washington 99350.

[2] Email from Scott Manley, Benton Conservation District, to Marc Liverman, National Marine Fisheries Service (February 23, 2001)(transmitting 2000 soil and water spreadsheet).

[3] Letter from B. Beyeler, City of Boardman, to M. Liverman, National Marine Fisheries Service (February 28, 2001)(describing test-pumping phase of Collector Well Project).

be met, an amount of water that is equivalent to the flow depletion caused by the new use, i.e., 76,686 acre-inches per year.[4]

The City's flow replacement plan is an extension of the same plan approved by NMFS (1998a) that matched up a new irrigation withdrawal with a soil and water conservation program administered by the BCD. As a requirement of the Corps' lease, when completed, the City's plan will meet the objective of "zero net impact" of the new diversion on flows needed by listed salmon in the Snake and Columbia Rivers. The flow replacement plan includes the following essential conditions:

- The City will provide a quantity of replacement flow that is equal to the full amount withdrawn by the new Collector Well No.2 by promoting changes in cropping patterns to reduce water consumption on nearby farms.

- The City will accomplish this by providing funds necessary to establish eligibility for farms to participate in a cost-share program known as the Environmental Quality Incentives Program (EQIP), or a comparable conservation program, administered by the BCD. The City will provide BCD with $100,000 for this purpose, to be paid in five installments due on or before April 1, 2003.

- Only those reductions in consumptive use that can be ascribed to permanent changes in crop patterns on farms participating in the permittee's enhancement of the BCD EQIP program will be credited for purposes of calculating replacement flow quantity.

- All increases in water availability due to reduced crop water demand on these lands will accrue to flows upstream of Collector Well No.2 in the John Day pool of the Columbia River.

- The City will ensure that diversion reduction agreements signed by the irrigation district are part the EQIP contract signed by participating farmers and BCD. The BCD will include clauses within each contract specifying the crop conversion condition and the reduced diversion amount.

- All acts necessary to accomplish crop conversions and provide full replacement flows will be completed by the City within six years.
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2. ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) (16 USC 1531-1544), amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and

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[4] One cfs equals 23.67 acre-inches per day (acre-inches day $^{-1}$) and planning dates for the flow management objectives are April 10 through August 31, a total of 135 days each year. Thus, the City's replacement flow obligation is equivalent to 22.57 cfs x (23.76 acre-inches day $^{-1}$ cfs $^{-1}$) x (143 days yr $^{-1}$) = 76,686 ac in yr $^{-1}$

plants and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service and NMFS, 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. This biological opinion is the product of an interagency consultation pursuant to Section 7(a)(2) of the ESA and implementing regulations found at 50 CFR Part 402.

2.1 Biological Opinion

The objective of this consultation is to determine whether the proposed lease for operation of the City's Collector Well No.2 and accompanying flow replacement plan is likely to jeopardize the continued existence of the following 12 listed ESUs of Columbia Basin salmonids, or cause the destruction or adverse modification of their designated critical habitat:

- Snake River (SR) spring/summer chinook salmon (*Oncorhynchus tshawytsch*a; listed as threatened on April 22, 1992 [57 FR 14653]); critical habitat designated on December 28,1993 [58 FR 68543], and revised on October 25, 1999 [64 FR 57399]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Snake River (SR) fall chinook salmon (*O. tshawytscha*; listed as threatened on April 22,1992 [57 FR 14653]); critical habitat designated on December 28, 1993 [58 FR 68543]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Upper Columbia River (UCR) spring chinook salmon *(O. tshawytsch*a; listed as endangered on March 24, 1999 [64 FR 14308]); critical habitat designated on February 16, 2000 [65 FR 7764]; ESA section 9 take prohibitions apply);

- Upper Willamette River (UWR) chinook salmon (*O. tshawytscha*; listed as threatened on March 24, 1999 [64 FR 14308]; critical habitat designated on Februarry 16, 2000 [65 FR 7764]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Lower Columbia River (LCR) chinook salmon (*O. tshawytscha*; listed as threatened on March 24, 1999 [64 FR 14308]; critical habitat designated on Februarry 16, 2000 [65 FR 7764]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Snake River (SR) steelhead *(O. mykis*s; listed as threatened on August 18, 1997 ([62 FR 43937]); critical habitat designated on February 16, 2000 [65 FR 7764]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Upper Columbia River (UCR) steelhead *(O. mykis*s; listed as endangered on August 18,1997 [62 FR 43937]); critical habitat designated on February 16, 2000 [65 FR 7764]; ESA section 9 take prohibition applies);

- Middle Columbia River (MCR) steelhead *(O. mykis*s; listed as threatened on March 25, 1999 ([64 FR 14517]); critical habitat designated on February 16, 2000 [65 FR 7764]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Upper Willamette River (UWR) steelhead *(O. mykis*s; listed as threatened on March 25, 1999 ([64 FR 14517]); critical habitat designated on February 16, 2000 [65 FR 7764]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Lower Columbia River (LCR) steelhead *(O. mykis*s; listed as threatened on March 19, 1998 ([63 FR 13347]); critical habitat designated on February 16, 2000 [65 FR 7764]; protective regulations were issued on July 10, 2000 [65 FR 42422]);

- Columbia River (CR) chum salmon *(O. keta)*; listed as threatened on March 25, 1999 ([64 FR 14508]); critical habitat designated on February 16, 2000 [65 FR 7764]; protective regulations were issued on July 10, 2000 [65 FR 42422]); and

- Snake River (SR) sockeye salmon *(O. nerk*a; listed as endangered on November 20, 1991 [56 FR 58619]); critical habitat designated on December 28, 1993 [58 FR 68543]; ESA section 9 take prohibition applies).

2.1.1 Biological Information

The proposed action is likely to affect the 12 listed ESUs of Columbia Basin salmonids listed above. Based on migratory and other life history timing, it is likely that adult and juvenile life stages of these listed species would be present in the proposed action area during the planning dates for flow management objectives and while water withdrawals are occurring.

The proposed action would occur within designated critical habitat for the listed salmon species. An action area is defined by NMFS regulations (50 CFR Part 402) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The area within designated critical habitat affected by the proposed action is the Columbia River at RM 268.0 downstream to the Pacific Ocean. This area serves as a migratory corridor for both adult and juvenile life stages 12 listed ESUs of Columbia Basin salmonids listed above. Each of these species also complete their growth and development to adulthood in the Columbia River plume. Moreover, the action area serves as rearing habitat for SR fall chinook, MCR steelhead, and SR sockeye, and as spawning and rearing habitat for CR chum salmon.

Essential features of critical habitat for the listed species are: (1) Substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food (juvenile only), (8) riparian vegetation, (9) space, and (10) safe passage conditions. The essential features this proposed project may affect are water quality, water quantity, water velocity, and safe passage conditions as a result of water withdrawal operations.

Additional background on listing status, biological information, and critical habitat elements for these 12 ESUs are described below. NMFS published the information summarized in this section previously as Appendix A to the paper "A Standardized Quantitative Analysis of the Risks Faced by Salmonids in the Columbia River Basin" (McClure et al. 2000a). Further details regarding the life histories, factors for decline, and current range wide status of these species are found in NMFS (2000).

2.1.1.1 Snake River (SR) Spring/Summer Chinook Salmon

The location, geology, and climate of the Snake River region create a unique aquatic ecosystem for chinook salmon. Spring- and/or summer-run chinook salmon are found in several subbasins of the Snake River (CBFWA 1990). Of these, the Grande Ronde and Salmon rivers are large, complex systems composed of several smaller tributaries that are further composed of many small streams. In contrast, the Tucannon and Imnaha rivers are small systems with most salmon production in the main river. In addition to these major subbasins, three small streams (Asotin, Granite, and Sheep creeks) that enter the Snake River between Lower Granite and Hells Canyon dams provide small spawning and rearing areas (CBFWA 1990). Although there are some indications that multiple ESUs may exist within the Snake Basin, the available data do not clearly demonstrate their existence or define their boundaries. Because of compelling genetic and life-history evidence that fall chinook salmon are distinct from other chinook salmon in the Snake River, however, they are considered a separate ESU.

Historically, spring and/or summer chinook salmon spawned in virtually all accessible and suitable habitat in the Snake River system (Evermann 1895; Fulton 1968). During the late 1800s, the Snake River produced a substantial fraction of all Columbia Basin spring and summer chinook salmon, with total production probably exceeding 1.5 million in some years. By the mid-1900s, the abundance of adult spring and summer chinook salmon had greatly declined. Fulton (1968) estimated that an average of 125,000 adults per year entered the Snake River tributaries from 1950 through 1960. As evidenced by adult counts at dams, however, spring and summer chinook salmon have declined considerably since the 1960s (Corps 1989).

In the Snake River, spring and summer chinook share key life history traits. Both are stream-type fish, with juveniles that migrate swiftly to sea as yearling smolts. Depending primarily on location within the basin (and not on run type), adults tend to return after either 2 or 3 years in the ocean. Both spawn and rear in small, high-elevation streams (Chapman et al. 1991), although where the two forms coexist, spring-run chinook spawn earlier and at higher elevations than summer-run chinook.

Even before mainstem dams were built, habitat was lost or severely damaged in small tributaries by construction and operation of irrigation dams and diversions, inundation of spawning areas by impoundments, and siltation and pollution from sewage, farming, logging, and mining (Fulton 1968). Recently, the construction of hydroelectric and water storage dams without adequate provision for adult and juvenile passage in the upper Snake River has kept fish from all spawning areas upstream of Hells Canyon Dam.

There is a long history of human efforts to enhance production of chinook salmon in the Snake Basin through supplementation and stock transfers. The evidence is mixed as to whether these efforts have altered the genetic makeup of indigenous populations. Straying rates appear to be very low.

For the SR spring/summer chinook salmon ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[5] 1 ranges from 0.96 to 0.80, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to the effectiveness of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated median population growth rates and the risk of absolute extinction for the seven spring/summer chinook salmon index stocks,[6] using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years for the wild component ranges from zero for Johnson Creek to 0.78 for the Imnaha River (Table B-5 in McClure et al. 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years ranges from zero for Johnson Creek to 1.00 for the wild component in the Imnaha River (Table B-6 in McClure et al. 2000b).

2.1.1.2 Snake River (SR) Fall Chinook Salmon

The Snake Basin drains an area of approximately 280,000 km^2 and incorporates a range of vegetative life zones, climatic regions, and geological formations, including the deepest canyon (Hells Canyon) in North America. The ESU includes the mainstem river and all tributaries, from their confluence with the Columbia River to the Hells Canyon complex. Because genetic analyses indicate that fall-run chinook salmon in the Snake River are distinct from the spring/summer-run in the Snake basin (Waples et al. 1991), SR fall chinook salmon are considered separately from the other two forms. They are also considered separately from those assigned to the UCR summer- and fall-run ESU because of considerable differences in habitat characteristics and adult ocean distribution and less definitive, but still significant, genetic differences. There is, however, some concern that recent introgression from Columbia River hatchery strays is causing the Snake River population to lose the qualities that made it distinct for ESA purposes.

SR fall chinook salmon remained stable at high levels of abundance through the first part of the twentieth century, but then declined substantially. Although the historical abundance of fall chinook salmon in the Snake River is difficult to estimate, adult returns appear to have declined by three orders of magnitude since the 1940s, and perhaps by another order of magnitude from pristine levels. Irving and Bjornn (1981) estimated that the mean number of fall chinook salmon returning to the Snake River declined from 72,000 during the period 1938 to 1949 to 29,000 during the 1950s. Further declines occurred upon completion of the Hells Canyon complex, which blocked access to primary production areas in the late 1950s (see below).

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[5] Estimates of median population growth rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period beginning in 1980 and including 1999 adult returns. Population trends are projected under the assumption that all conditions will stay the same into the future.

[6] McClure et al. (2000c) have calculated population trend parameters for additional SR spring/summer chinook salmon stocks.

Fall chinook salmon in this ESU are ocean-type. Adults return to the Snake River at ages 2 through 5, with age 4 most common at spawning (Chapman et al. 1991). Spawning, which takes place in late fall, occurs in the mainstem and in the lower parts of major tributaries (NWPPC 1989; Bugert et al. 1990). Juvenile fall chinook salmon move seaward slowly as subyearlings, typically within several weeks of emergence (Chapman et al. 1991). Based on modeling by the Chinook Technical Committee, the Pacific Salmon Commission estimates that a significant proportion of the SR fall chinook (about 36%) are taken in Alaska and Canada, indicating a far-ranging ocean distribution. In recent years, only 19% were caught off Washington, Oregon, and California, with the balance (45%) taken in the Columbia River (Simmons 2000).

With hydrosystem development, the most productive areas of the Snake Basin are now inaccessible or inundated. The upper reaches of the mainstem Snake River were the primary areas used by fall chinook salmon, with only limited spawning activity reported downstream from river kilometer (Rkm) 439. The construction of Brownlee Dam (1958; Rkm 459), Oxbow Dam (1961; Rkm 439), and Hells Canyon Dam (1967; Rkm 397) eliminated the primary production areas of SR fall chinook salmon. There are now 12 dams on the mainstem Snake River, and they have substantially reduced the distribution and abundance of fall chinook salmon (Irving and Bjornn 1981).

The Snake River has contained hatchery-reared fall chinook salmon since 1981 (Busack 1991). The hatchery contribution to Snake River escapement has been estimated at greater than 47 percent (Myers et al. 1998). Artificial propagation is recent, so cumulative genetic changes associated with it may be limited. Wild fish are incorporated into the brood stock each year, which should reduce divergence from the wild population. Release of subyearling fish may also help minimize the differences in mortality patterns between hatchery and wild populations that can lead to genetic change (Waples 1999). (See NMFS [1999a] for further discussion of the SR fall chinook salmon supplementation program.)

Some SR fall chinook historically migrated over 1,500 km from the ocean. Although the Snake River population is now restricted to habitat in the lower river, genes associated with the lengthier migration may still reside in the population. Because longer freshwater migrations in chinook salmon tend to be associated with more-extensive oceanic migrations (Healey 1983), maintaining populations occupying habitat that is well inland may be important in continuing diversity in the marine ecosystem as well.

For the SR fall chinook salmon ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[7] ranges from 0.94 to 0.86, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated the risk of absolute extinction for the aggregate SR fall chinook salmon population, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk

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[7] Estimates of median population grow th rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trend s observe d during a base period beginning in 1980 and including 199 6 adult returns. Population trends are projected under the assumption that all conditions will stay the same into the future.

of absolute extinction within 100 years is 0.40 (Table B-5 in McClure et al. 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 1.00 (Table B-6 in McClure et al. 2000b).

2.1.1.3 Upper Columbia River (UCR) Spring-run Chinook Salmon

This ESU includes spring-run chinook populations found in Columbia River tributaries between the Rock Island and Chief Joseph dams, notably the Wenatchee, Entiat, and Methow River basins. The populations are genetically and ecologically separate from the summer- and fall-run populations in the lower parts of many of the same river systems (Myers et al. 1998). Although fish in this ESU are genetically similar to spring chinook in adjacent ESUs (i.e., mid-Columbia and Snake), they are distinguished by ecological differences in spawning and rearing habitat preferences. For example, spring-run chinook in upper Columbia tributaries spawn at lower elevations (500 to 1,000 m) than in the Snake and John Day River systems.

The upper Columbia River populations were intermixed during the Grand Coulee Fish Maintenance Project (1939 through 1943), resulting in loss of genetic diversity between populations in the ESU. Homogenization remains an important feature of the ESU. Fish abundance has trended downward both recently and over the long term. At least six former populations from this ESU are now extinct, and nearly all extant populations have fewer than 100 wild spawners.

UCR spring chinook are considered stream-type fish, with smolts migrating as yearlings. Most stream-type fish mature at 4 years of age. Few coded-wire tags are recovered in ocean fisheries, suggesting that the fish move quickly out of the north central Pacific and do not migrate along the coast.

Spawning and rearing habitat in the Columbia River and its tributaries upstream of the Yakima River includes dry areas where conditions are less conducive to steelhead survival than in many other parts of the Columbia basin (Mullan et al. 1992a). Salmon in this ESU must pass up to nine Federal and private dams, and Chief Joseph Dam prevents access to historical spawning grounds farther upstream. Degradation of remaining spawning and rearing habitat continues to be a major concern associated with urbanization, irrigation projects, and livestock grazing along riparian corridors. Overall harvest rates are low for this ESU, currently less than 10% (ODFW and WDFW 1995).

Spring-run chinook salmon from the Carson National Fish Hatchery (a large composite, non-native stock) were introduced into and have been released from local hatcheries (Leavenworth, Entiat, and Winthrop National Fish Hatcheries [NFH]). Little evidence suggests that these hatchery fish stray into wild areas or hybridize with naturally spawning populations. In addition to these national production hatcheries, two supplementation hatcheries are operated by the WDFW in this ESU. The Methow Fish Hatchery Complex (operations began in 1992) and the Rock Island Fish Hatchery Complex (operations began in 1989) were both designed to implement supplementation programs for naturally spawning populations on the Methow and Wenatchee rivers, respectively (Chapman et al. 1995).

For the UCR spring chinook salmon ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[8] ranges from 0.85 to 0.83, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated median population growth rates and the risk of absolute extinction for the three spawning populations identified by Ford et al. (1999), using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from 0.97 for the Methow River to 1.00 for the Methow and Entiat rivers (Table B-5 in McClure et al. 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of extinction within 100 years is 1.00 for all three spawning populations (Table B-6 in McClure et al. 2000b).

NMFS has also used population risk assessments for UCR spring chinook salmon and steelhead ESUs from the draft QAR (Cooney 2000). Risk assessments described in that report were based on Monte Carlo simulations with simple spawner/spawner models that incorporate estimated smolt carrying capacity. Population dynamics were simulated for three separate spawning populations in the UCR spring chinook salmon ESU, the Wenatchee, Entiat, and Methow populations. The QAR assessments showed extinction risks for UCR spring chinook salmon of 50% for the Methow, 98% for the Wenatchee, and 99% for the Entiat spawning populations. These estimates are based on the assumption that the median return rate for the 1980 brood year to the 1994 brood year series will continue into the future.

2.1.1.4 Upper Willamette River (UWR) Chinook Salmon

The UWR chinook ESU includes native spring-run populations above Willamette Falls and in the Clackamas River. In the past, it included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Although the total number of fish returning to the Willamette has been relatively high (24,000), about 4,000 fish now spawn naturally in the ESU, two-thirds of which originate in hatcheries. The McKenzie River supports the only remaining naturally reproducing population in the ESU (Odfw (1998b).

There are no direct estimates of the size of the chinook salmon runs in the Willamette Basin before the 1940s. McKernan and Mattson (1950) present anecdotal information that the native American fishery at the Willamette Falls may have yielded 2,000,000 lb (908,000 kg) of salmon (454,000 fish, each weighing 20 lb [9.08 kg]). Based on egg collections at salmon hatcheries, Mattson (1948) estimates that the spring chinook salmon run in the 1920s may have been 5 times the run size of 55,000 fish in 1947, or 275,000 fish. Much of the early information on salmon runs in the upper Willamette Basin comes from operation reports of state and Federal hatcheries.

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[8] Estimates of median population growth rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observe d during a base period beginning in 1980 and including 199 8 adult returns. Population trends are projected under the assumption that all conditions will stay the same into the future.

Fish in this ESU are distinct from those of adjacent ESUs in life history and marine distribution. The life history of chinook salmon in the Upper Willamette River ESU includes traits from both ocean- and stream-type development strategies. Coded-wire-tag (CWT) recoveries indicate that the fish travel to the marine waters off British Columbia and Alaska. More Willamette fish are, however, recovered in Alaskan waters than fish from the Lower Columbia River ESU. UWR chinook mature in their fourth or fifth years. Historically, 5-year-old fish dominated the spawning migration runs; recently, however, most fish have matured at age 4. The timing of the spawning migration is limited by Willamette Falls. High flows in the spring allow access to the upper Willamette basin, whereas low flows in the summer and autumn prevent later-migrating fish from ascending the falls. The low flows may serve as an isolating mechanism, separating this ESU from others nearby.

Human activities have had enormous effects on the salmonid populations in the Willamette drainage. First, the Willamette River, once a highly braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat (i.e., stream shoreline) by as much as 75%. In addition, the construction of 37 dams in the basin has blocked access to over 700 km of stream and river spawning habitat. The dams also alter the temperature regime of the Willamette and its tributaries, affecting the timing of development of naturally spawned eggs and fry. Water quality is also affected by development and other economic activities. Agricultural and urban land uses on the valley floor, as well as timber harvesting in the Cascade and Coast ranges, contribute to increased erosion and sediment load in Willamette basin streams and rivers. Finally, since at least the 1920s, the lower Willamette has suffered municipal and industrial pollution.

Hatchery production in the basin began in the late nineteenth century. Eggs were transported throughout the basin, resulting in current populations that are relatively homogeneous genetically (although still distinct from those of surrounding ESUs). Hatchery production continues in the Willamette, with an average of 8.4 million smolts and fingerlings released each year into the main river or its tributaries between 1975 and 1994. Hatcheries are currently responsible for most production (90% of escapement) in the basin. The Clackamas River currently accounts for about 20% of the production potential in the Willamette Basin, originating from one hatchery plus natural production areas that are primarily located above the North Fork Dam. The interim escapement goal for the area above North Fork Dam is 2,900 fish (ODFW 1998c). However, the system is so heavily influenced by hatchery production that it is difficult to distinguish spawners of natural stock from hatchery origin fish. Approximately 1,000 to 1,500 adults have been counted at the North Fork Dam in recent years.

Harvest on this ESU is high, both in the ocean and inriver. The total inriver harvest below the falls from 1991 through 1995 averaged 33% and was much higher before then. Ocean harvest was estimated as 16% for 1982 through 1989. Odfw (1998a) indicates that total (marine and freshwater) harvest rates on UWR spring-run stocks were reduced considerably for the 1991 through 1993 brood years, to an average of 21%.

For the UWR chinook salmon ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[9] ranges from 1.01 to 0.63, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated the risk of absolute extinction for the aggregate UWR chinook salmon population in the McKenzie River, above Leaburg, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years is 0.01 (Table B-5 in McClure et al. 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 0.85 (Table B-6 in McClure et al. 2000b).

2.1.1.5 Lower Columbia River (LCR) Chinook Salmon

The Lower Columbia River ESU is characterized by numerous short- and medium-length rivers that drain the coast ranges and the west slope of the Cascade Mountains. This ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The former location of Celilo Falls (drowned by The Dalles reservoir in 1960) is the eastern boundary for this ESU. Stream-type, spring-run chinook salmon found in the Klickitat River or the introduced Carson spring-chinook salmon strain are not included in this ESU. Spring-run chinook salmon in the Sandy River have been influenced by spring-run chinook salmon introduced from the Willamette River ESU. However, analyses suggest that considerable genetic resources still reside in the existing population (Meyers et al. 1998). Recent escapements above Marmot Dam on the Sandy River average 2,800 and have been increasing (ODFWa). Tule fall chinook from the LCR chinook salmon ESU were observed spawning in the Ives Island area during October 1999. The Hardy/Hamilton creeks/Ives Island complex is located along the Washington shoreline approximately 2 miles below Bonneville Dam.

Historical records of chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run chinook salmon are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays. Furthermore, spring-run populations have been severely depleted throughout the ESU and extirpated from several rivers.

Most fall-run fish in the LCR chinook salmon ESU emigrate to the marine environment as subyearlings (Reimers and Loeffel 1967, Howell et al. 1985, WDF et al. 1993). Returning adults that emigrated as yearling smolts may have originated from the extensive hatchery programs in the ESU. It is also possible that modifications in the river environment have altered the duration of freshwater residence. CWT recoveries of Lower Columbia River ESU fish suggest a northerly migration route, but (based on CWT recoveries) the fish contribute more to fisheries off British Columbia and Washington than to the Alaskan fishery. Tule fall chinook salmon

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[9] Estimates of median population grow th rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trend s observe d during a base period beginning in 1980 and including 1998 adult returns. Population trend s are projected under the assumption that all condition s will stay the same into the future.

return at adult ages 3 and 4; "bright" fall chinook return at ages 4 and 5, with significant numbers returning at age 6. Tule and bright chinook salmon are distinct in their spawn timing.

As in other ESUs, chinook salmon have been affected by the alteration of freshwater habitat (Bottom et al. 1985, WDF et al. 1993, Kostow 1995). Timber harvesting and associated road building peaked in the 1930s, but effects from the timber industry remain (Kostow 1995). Agriculture is widespread in this ESU and has affected riparian vegetation and stream hydrology. The ESU is also highly affected by urbanization, including river diking and channelization, wetland draining and filling, and pollution (Kostow 1995).

The Lower Columbia River ESU has been subject to intensive hatchery influence. Hatchery programs to enhance chinook salmon fisheries in the lower Columbia River began in the 1870s, releasing billions of fish over time. That equals the total hatchery releases for all other chinook ESUs combined (Myers et al. 1998). Although most of the stocks have come from inside the ESU, more than 200 million fish from outside the ESU have been released since 1930 (Myers et al. 1998).

For the LCR chinook salmon ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[10] ranges from 0.98 to 0.88, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS estimated the risk of absolute extinction for nine spawning aggregations,[7] using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the Sandy River late run and Big Creek to 1.00 for Mill Creek (Table B-5 in McClure et al. 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 0.99 for all but one of nine spawning aggregations (zero for the Sandy River late run; Table B-6 in McClure et al. 2000b).

2.1.1.6 Snake River (SR) Steelhead

Steelhead spawning habitat in the Snake River is distinctive in having large areas of open, low-relief streams at high elevations. In many Snake River tributaries, spawning occurs at a higher elevation (up to 2,000 m) than for steelhead in any other geographic region. SR steelhead also migrate farther from the ocean (up to 1,500 km) than most.

No estimates of historical (pre-1960s) abundance specific to this ESU are available.

Fish in this ESU are summer steelhead. They enter freshwater from June to October and spawn during the following March to May. Two groups are identified, based on migration timing,

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[10] Estimates of median population grow th rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period beginning in 1980 and including 1997 adult returns for most spawning aggregations. Population trends are projected under the assumption that all conditions will stay the same into the future.

ocean-age, and adult size. A-run steelhead, thought to be predominately age-1-ocean, enter freshwater during June through August. B-run steelhead, thought to be age-2-ocean, enter freshwater during August through October. B-run steelhead typically are 75 to 100 mm longer at the same age. Both groups usually smolt as 2- or 3-year-olds (Whitt 1954, Hassemer 1992). All steelhead are iteroparous, capable of spawning more than once before death.

Hydrosystem projects create substantial habitat blockages in this ESU; the major ones are the Hells Canyon Dam complex (mainstem Snake River) and Dworshak Dam (North Fork Clearwater River). Minor blockages are common throughout the region. Steelhead spawning areas have been degraded by overgrazing, as well as by historical gold dredging and sedimentation due to poor land management. Habitat in the Snake basin is warmer and drier and often more eroded than elsewhere in the Columbia Basin or in coastal areas.

Hatchery fish are widespread and stray to spawn naturally throughout the region. In the 1990s, an average of 86% of adult steelhead passing Lower Granite Dam were of hatchery origin. Hatchery contribution to naturally spawning populations varies, however, across the region. Hatchery fish dominate some stocks, but do not contribute to others.

For the SR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[11] ranges from 0.91 to 0.70, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated the risk of absolute extinction for the A- and B-runs, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years is 0.01 for A-run steelhead and 0.93 for B-run fish (Table B-5 in McClure et al. 2000b). At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 1.00 for both runs (Table B-6 in McClure et al. 2000b).

2.1.1.7 Upper Columbia River (UCR) Steelhead

This ESU occupies the Columbia Basin upstream of the Yakima River. Rivers in the area primarily drain the east slope of the northern Cascade Mountains and include the Wenatchee, Entiat, Methow, and Okanogan River basins. The climate of the area reaches temperature and precipitation extremes; most precipitation falls as mountain snow (Mullan et al. 1992b). The river valleys are deeply dissected and maintain low gradients, except for the extreme headwaters (Franklin and Dyrness 1973).

Estimates of historical (pre-1960s) abundance specific to this ESU are available from fish counts at dams. Counts at Rock Island Dam from 1933 to 1959 averaged 2,600 to 3,700, suggesting a

[11] Estimates of median population grow th rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period beginning in 1980 and including 1997 adult returns. Population trends are projected under the assumption that all conditions will stay the same into the future.

prefishery run size exceeding 5,000 adults for tributaries above Rock Island Dam (Chapman et al. 1994). Runs may, however, already have been depressed by lower Columbia River fisheries.

As in other inland ESUs (the Snake and mid-Columbia Basins), steelhead in the Upper Columbia River ESU remain in freshwater up to a year before spawning. Smolt age is dominated by 2-year-olds. Based on limited data, steelhead from the Wenatchee and Entiat rivers return to freshwater after 1 year in salt water, whereas Methow River steelhead are primarily age-2-ocean (Howell et al. 1985). Life history characteristics for UCR steelhead are similar to those of other inland steelhead ESUs; however, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU. The relationship between anadromous and nonanadromous forms in the geographic area is unclear.

The Chief Joseph and Grand Coulee dam construction caused blockages of substantial habitat, as did that of smaller dams on tributary rivers. Habitat issues for this ESU relate mostly to irrigation diversions and hydroelectric dams, as well as to degraded riparian and instream habitat from urbanization and livestock grazing.

Hatchery fish are widespread and escape to spawn naturally throughout the region. Spawning escapement is dominated by hatchery-produced fish.

For the UCR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[12] ranges from 0.94 to 0.66, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated the risk of absolute extinction for the aggregate UCR steelhead population, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years is 0.25 (Table B-5 in McClure et al. 2000b). Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 1.00 (Table B-6 in McClure et al. 2000b). Because of data limitations, the QAR steelhead assessments in Cooney (2000) were limited to two aggregate spawning groups—the Wenatchee/Entiat composite and the above-Wells populations. Wild production of steelhead above Wells Dam was assumed to be limited to the Methow system. Assuming a relative effectiveness of hatchery spawners of 1.0, the risk of absolute extinction within 100 years for UCR steelhead is 100%. The QAR also assumed hatchery effectiveness values of 0.25 and 0.75. A hatchery effectiveness of 0.25 resulted in projected risks of extinction of 35% for the Wenatchee/Entiat and 28% for the Methow populations. At a hatchery effectiveness of 0.75, risks of 100% were projected for both populations.

2.1.1.8 Middle Columbia River (MCR) Steelhead

[12] Estimates of median population growth rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period beginning in 1980 and including 1996 adult returns. Population trends are projected under the assumption that all conditions will stay the same into the future.

The Middle Columbia River ESU occupies the Columbia Basin from above the Wind River in Washington and the Hood River in Oregon and continues upstream to include the Yakima River, Washington. The region includes some of the driest areas of the Pacific Northwest, generally receiving less than 40 cm of precipitation annually (Jackson 1993). Summer steelhead are widespread throughout the ESU; winter steelhead occur in Mosier, Chenowith, Mill, and Fifteenmile creeks, Oregon, and in the Klickitat and White Salmon rivers, Washington. The John Day River probably represents the largest native, natural spawning stock of steelhead in the region.

Estimates of historical (pre-1960s) abundance specific to this ESU are available for the Yakima River, which has an estimated run size of 100,000 (WDF et al. 1993). Assuming comparable run sizes for other drainage areas in this ESU, the total historical run size may have exceeded 300,000 steelhead.

Most fish in this ESU smolt at 2 years and spend 1 to 2 years in salt water before reentering freshwater, where they may remain up to a year before spawning (Howell et al. 1985, BPA 1992). All steelhead upstream of The Dalles Dam are summer-run (Schreck et al. 1986, Reisenbichler et al. 1992, Chapman et al. 1994). The Klickitat River, however, produces both summer and winter steelhead, and age-2-ocean steelhead dominate the summer steelhead, whereas most other rivers in the region produce about equal numbers of both age-1- and 2-ocean fish. A nonanadromous form co-occurs with the anadromous form in this ESU; information suggests that the two forms may not be isolated reproductively, except where barriers are involved.

The only substantial habitat blockage now present in this ESU is at Pelton Dam on the Deschutes River, but minor blockages occur throughout the region. Water withdrawals and overgrazing have seriously reduced summer flows in the principal summer steelhead spawning and rearing tributaries of the Deschutes River. This is significant because high summer and low winter temperatures are limiting factors for salmonids in many streams in this region (Bottom et al. 1985).

Continued increases in the proportion of stray steelhead in the Deschutes Basin is a major concern. The ODFW and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) estimate that 60% to 80% of the naturally spawning population consists of strays, which greatly outnumber naturally produced fish. Although the reproductive success of stray fish has not been evaluated, their numbers are so high that major genetic and ecological effects on natural populations are possible (Busby et al. 1999). The negative effects of any interbreeding between stray and native steelhead will be exacerbated if the stray steelhead originated in geographically distant river basins, especially if the river basins are in different ESUs. The populations of steelhead in the Deschutes Basin include the following:

- Steelhead native to the Deschutes River
- Hatchery steelhead from the Round Butte Hatchery on the Deschutes River
- Wild steelhead strays from other rivers in the Columbia Basin
- Hatchery steelhead strays from other Columbia Basin streams

Regarding the latter, CTWSRO reports preliminary findings from a tagging study by T. Bjornn and M. Jepson (University of Idaho) and NMFS suggesting that a large fraction of the steelhead passing through Columbia River dams (e.g., John Day and Lower Granite dams) have entered the Deschutes River and then returned to the mainstem Columbia River. A key unresolved question about the large number of strays in the Deschutes basin is how many stray fish remain in the basin and spawn naturally.

For the MCR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[13]10 ranges from 0.88 to 0.75, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated the risk of absolute extinction for four of the spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the Yakima River summer run to 1.00 for the Umatilla River and Deschutes River summer runs (Table B-5 in McClure et al. 2000b). Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years ranges from zero for the Yakima River summer run to 1.00 for the Deschutes River summer run (Table B-6 in McClure et al. 2000b).

2.1.1.9 Upper Willamette River (UWR) Steelhead

The UWR steelhead ESU occupies the Willamette River and tributaries upstream of Willamette Falls, extending to and including the Calapooia River. These major river basins containing spawning and rearing habitat comprise more than 12,000 km^2 in Oregon. Rivers that contain naturally spawning winter-run steelhead include the Tualatin, Molalla, Santiam, Calapooia, Yamhill, Rickreall, Luckiamute, and Mary's, although the origin and distribution of steelhead in a number of these basins is being debated. Early migrating winter and summer steelhead have been introduced into the upper Willamette Basin, but those components are not part of the ESU.

Native winter steelhead within this ESU have been declining since 1971 and have exhibited large fluctuations in abundance.

In general, native steelhead of the upper Willamette Basin are late-migrating winter steelhead, entering freshwater primarily in March and April. This atypical run timing appears to be an adaptation for ascending Willamette Falls, which functions as an isolating mechanism for UWR steelhead. Reproductive isolation resulting from the falls may explain the genetic distinction between steelhead from the upper Willamette Basin and those in the lower river. UWR late-migrating steelhead are ocean-maturing fish. Most return at age 4, with a small proportion returning as 5-year-olds (Busby et al. 1996).

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[13] Estimates of median population grow th rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period that varies between spawning aggregations. Population trends are projected under th e assumption that all condition s will stay the same into the future.

Willamette Falls (Rkm 77) is a known migration barrier. Winter steelhead and spring chinook salmon historically occurred above the falls, whereas summer steelhead, fall chinook, and coho salmon did not. Detroit and Big Cliff dams cut off 540 km of spawning and rearing habitat in the North Santiam River. In general, habitat in this ESU has become substantially simplified since the 1800s by removal of large woody debris to increase the river's navigability.

The main hatchery production of native (late-run) winter steelhead occurs in the North Fork Santiam River, where estimates of hatchery proportion in natural spawning areas range from 14% to 54% (Busby et al. 1996). More recent estimates of the percentage of naturally spawning fish attributable to hatcheries in the late 1990s are 24% in the Molalla, 17% in the North Santiam, 5% to 12% in the South Santiam, and less than 5% in the Calapooia (Chilcote 1997).

For the UWR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[14] ranges from 0.94 to 0.87, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated the risk of absolute extinction for four spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the South Santiam River to 0.74 for the Calapooia River (Table B-5 in McClure et al. 2000b). Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years ranges from 0.74 for the Calapooia River to 1.00 for the Molalla River and South Santiam River spawning aggregations (Table B-6 in McClure et al. 2000b).

2.1.1.10 Lower Columbia River (LCR) Steelhead

The Lower Columbia River ESU encompasses all steelhead runs in tributaries between the Cowlitz and Wind rivers on the Washington side of the Columbia, and the Willamette and Hood rivers on the Oregon side. The populations of steelhead that make up the Lower Columbia River ESU are distinguished from adjacent populations by genetic and habitat characteristics. The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the upper Willamette basin and coastal runs north and south of the Columbia River mouth. Not included in the ESU are runs in the Willamette River above Willamette Falls (Upper Willamette River ESU), runs in the Little and Big White Salmon rivers (Middle Columbia River ESU) and runs based on four imported hatchery stocks: early-spawning winter Chambers Creek/lower Columbia River mix, summer Skamania Hatchery stock, winter Eagle Creek NFH stock, and winter Clackamas River ODFW stock (63 FR 13351 and 13352). This area has at least 36 distinct runs (Busby et al. 1996), 20 of which were identified in the initial listing petition. In addition, numerous small tributaries have historical reports of fish, but no current abundance data. The major runs in the

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[14] Estimates of median population grow th rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period beginning in 1980 and including 199 7 adult returns. Population trend s are projected under the assumption that all conditions will stay the same into the future.

ESU, for which there are estimates of run size, are the Cowlitz River winter runs, Toutle River winter runs, Kalama River winter and summer runs, Lewis River winter and summer runs, Washougal River winter and summer runs, Wind River summer runs, Clackamas River winter and summer runs, Sandy River winter and summer runs, and Hood River winter and summer runs.

For the larger runs, current counts have been in the range of one to 2,000 fish (Cowlitz, Kalama, and Sandy rivers); historical counts, however, put these runs at more than 20,000 fish. In general, all runs in the ESU have declined over the past 20 years, with sharp declines in the last 5 years.

Steelhead in this ESU are thought to use estuarine habitats extensively during outmigration, smoltification, and spawning migrations. The lower reaches of the Columbia River are highly modified by urbanization and dredging for navigation. The upland areas covered by this ESU are extensively logged, affecting water quality in the smaller streams used primarily by summer runs. In addition, all major tributaries used by LCR steelhead have some form of hydraulic barrier that impedes fish passage. Barriers range from impassible structures in the Sandy Basin that block access to extensive, historically occupied, steelhead habitat, to passable but disruptive projects on the Cowlitz and Lewis rivers. The Biological Review Team (BRT 1997) viewed the overall effect of hydrosystem activities on this ESU as an important determinant of extinction risk.

Many populations of steelhead in the Lower Columbia River ESU are dominated by hatchery escapement. Roughly 500,000 hatchery-raised steelhead are released into drainages within this ESU each year. As a result, first-generation hatchery fish are thought to make up 50% to 80% of the fish counted on natural spawning grounds. The effect of hatchery fish is not uniform, however. Several runs are mostly hatchery strays (e.g., the winter run in the Cowlitz River [92%] and the Kalama River [77%] and the summer run in the North Fork Washougal River [50%]), whereas others are almost free of hatchery influence (the summer run in the mainstem Washougal River [0%] and the winter runs in the North Fork Toutle and Wind rivers [0% to 1%]).

Escapement estimates for the steelhead fishery in the Lower Columbia River ESU are based on inriver and estuary sport-fishing reports; there is a limited ocean fishery on this ESU. Harvest rates range from 20% to 50% on the total run, but for hatchery-wild differentiated stocks, harvest rates on wild fish have dropped to 0% to 4% in recent years (punch card data from WDFW through 1994).

For the LCR steelhead ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[15] ranges from 0.98 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000b). NMFS has also estimated the risk of absolute extinction for

[15] Estimates of median population growth rate, risk of extinction, and the likelihood of meeting recovery goals are based on population trends observed during a base period that varies between spawning aggregations. Population trends are projected under the assumption that all conditions will stay the same into the future.

seven of the spawning aggregations, using the same range of assumptions about the relative effectiveness of hatchery fish. At the low end, assuming that hatchery fish spawning in the wild have not reproduced (i.e., hatchery effectiveness = 0), the risk of absolute extinction within 100 years ranges from zero for the Kalama River summer run and the Clackamas River and Kalama River winter runs to 1.00 for the Clackamas River summer run and the Toutle River winter run (Table B-5 in McClure et al. 2000b). Assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years rises to 1.00 for all but one population (the risk of extinction is 0.86 for the Green River winter run; Table B-6 in McClure et al. 2000b).

2.1.1.11 Columbia River (CR) Chum Salmon

Chum salmon of the Columbia River ESU spawn in tributaries and in mainstem spawning areas below Bonneville Dam. Most fish spawn on the Washington side of the Columbia River (Johnson et al. 1997). Previously, chum salmon were reported in almost every river in the lower Columbia Basin, but most runs disappeared by the 1950s (Rich 1942, Marr 1943, Fulton 1970). Currently, WDFW regularly monitors only a few natural populations in the basin, one in Grays River, two in small streams near Bonneville Dam, and the mainstem area next to one of the latter two streams.

Chum salmon enter the Columbia River from mid-October through early December and spawn from early November to late December. Recent genetic analysis of fish from Hardy and Hamilton creeks and from the Grays River indicate that these fish are genetically distinct from other chum salmon populations in Washington. Genetic variability within and between populations in several geographic areas is similar, and populations in Washington show levels of genetic subdivision typical of those seen between summer- and fall-run populations in other areas and typical of populations within run types (Salo 1991, WDF et al. 1993, Phelps et al. 1994, and Johnson et al. 1997).

Historically, the CR chum salmon ESU supported a large commercial fishery, landing more than 500,000 fish per year. Commercial catches declined beginning in the mid-1950s. There are now no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho and chinook salmon, and some tributaries have a minor recreational harvest (WDF et al. 1993).

Hatchery fish have had little influence on the wild component of the CR chum salmon ESU. NMFS estimates an median population growth rate (lambda) over the base period,[13] for the ESU as a whole, of 1.04 (Tables B-2a and B-2b in McClure et al. 2000b). Because census data are peak counts (and because the precision of those counts decreases markedly during the spawning season as water levels and turbidity rise), NMFS is unable to estimate the risk of absolute extinction for this ESU.

2.1.1.12 Snake River (SR) Sockeye Salmon

The only remaining sockeye in the Snake River system are found in Redfish Lake, on the Salmon River. The nonanadromous form (kokanee), found in Redfish Lake and elsewhere in the

Snake Basin, is included in the ESU. Snake River sockeye were historically abundant in several lake systems of Idaho and Oregon. However, all populations have been extirpated in the past century, except fish returning to Redfish Lake.

In general, juvenile sockeye salmon rear in the lake environment for 1, 2, or 3 years before migrating to sea. Adults typically return to the natal lake system to spawn after spending 1, 2, 3, or 4 years in the ocean (Gustafson et al. 1997).

In 1910, impassable Sunbeam Dam was constructed 20 miles downstream of Redfish Lake. Although several fish ladders and a diversion tunnel were installed during subsequent decades, it is unclear whether enough fish passed above the dam to sustain the run. The dam was partly removed in 1934, after which Redfish Lake runs partially rebounded. Evidence is mixed as to whether the restored runs constitute anadromous forms that managed to persist during the dam years, nonanadromous forms that became migratory, or fish that strayed in from outside the ESU.

NMFS proposed an interim recovery level of 2,000 adult Snake River sockeye salmon in Redfish Lake and two other lakes in the Snake Basin (Table 1.3-1 in NMFS 1995b). Low numbers of adult SR sockeye salmon preclude a CRI- or QAR-type quantitative analysis of the status of this ESU. Because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley basin between 1990 and 2000, however, NMFS considers the status of this ESU to be dire under any criteria. Clearly the risk of extinction is very high.

2.1.2 Evaluating the Proposed Action

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). NMFS must determine whether the action is likely to jeopardize the listed species and/or whether the action is likely to destroy or adversely modify critical habitat. This analysis involves the: 1) Definition of the biological requirements and current status of the listed species; and 2) evaluation of the relevance of the environmental baseline to the species' current status.

Subsequently, NMFS evaluates whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NMFS must consider the estimated level of mortality attributable to: 1) Collective effects of the proposed or continuing action; 2) the environmental baseline; and 3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed salmonid's life stages that occur beyond the action area. If NMFS finds that the action is likely to jeopardize, NMFS must identify reasonable and prudent alternatives for the action.

Furthermore, NMFS evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' designated critical habitat. The NMFS must determine whether habitat modifications appreciably diminish the value of critical habitat for both survival and recovery of the listed species. The NMFS identifies those effects of the action that impair the function of any essential element of critical habitat. The NMFS then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NMFS concludes that the action will destroy or adversely modify critical habitat it must identify any reasonable and prudent alternatives available.

For the subject actions, NMFS' jeopardy analysis considers direct or indirect mortality of fish attributable to the actions. NMFS' critical habitat analysis considers the extent to which the proposed action impairs the function of essential biological elements necessary for juvenile and adult migration, spawning, and rearing of the MCR steelhead under the existing environmental baseline.

2.1.2.1 Biological Requirements in the Action Area

The first step the NMFS uses when applying the ESA section 7(a)(2) to the 12 listed ESUs considered in this Opinion is to define the species' biological requirements that are most relevant to each consultation. The NMFS also considers the current status of the listed species taking into account population size, trends, distribution and genetic diversity. To assess the current status of the listed species, NMFS starts with the determinations made in its decision to list the 12 ESUs considered in this Opinion for ESA protection and also considers new data available that is relevant to the determination.

Relevant biological requirements are those necessary for the 12 listed ESU's to survive and recover to naturally reproducing population levels at which protection under the ESA would become unnecessary. This will occur when population levels are adequate to safeguard the genetic diversity of the listed ESUs, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment. For this consultation, the relevant biological requirements are improved water quality, water quantity, water temperature, water velocity and safe passage conditions that function to support successful adult and juvenile migration, spawning and rearing, and growth and development to adulthood. Meeting those requirements depends largely on allowing natural hydrologic processes to increase their ecological function, while at the same time removing adverse impacts of current practices.

A synthesis of scientific information regarding the effects of hydrologic processes in the Columbia River hydropower system established that a general relationship exists between increasing fish travel time and increasing river flows for chinook salmon that migrate in the summer, and between survival and increasing river flows for juvenile fall chinook (NFSC 2000). Further, increased flows are hypothesized to provide survival benefits downstream from the hydropower system for listed salmonids as they migrate through the estuary and into the nearshore environment. The relationship between flow and survival is not well understood and may vary at different flows and in different years. Nonetheless, water velocity, spill, gas saturation, flooding, and temperature are all flow-related habitat conditions that are believed to be causal factors that mediate fish survival by influencing fish migration speed, predation, the route of passage at a dam, feeding, growth, and gas bubble trauma (ISG 1996). Research is underway to more clearly explain the causal factors and to learn which flows (or associated causal factors) are necessary for survival and recovery of listed salmonids.

Until additional research results are available, the 1995 Federal Columbia River Power System (FCRPS) biological opinion established interim flow objectives to aid in improving survival of listed Snake River salmon smolts (NMFS 1995a). The flow objectives were developed with consideration for historical river flows and velocities, which were much higher than now; an analysis of the increase in juvenile travel times associated with lower river flows, which increases exposure to predation and may disrupt optimum timing of ocean entry; and the observation that years with low river flows do not correspond with years of good adult returns. The 1995 FCRPS biological opinion also specified management of Snake and Columbia River water to improve the ability of the FCRPS to achieve the flow objectives. Some additional information has become available since development of the instream flow objectives that supports the conclusion that increased flow is associated with increased juvenile survival, particularly for fall chinook, which migrate during the summer months. (NMFS 1998b, 2000 and NFSC 2000).

Based on that information, seasonal flow objectives and planning dates for the mainstem Columbia and Snake Rivers have been expanded to include benefits for juvenile Columbia River salmon, and are as follows (NMFS 2000).

	Spring		Summer	
Location	Dates	Objective[1]	Dates	Objective
Snake River at Lower Granite Dam	4/03 - 6/20	85 - 100[2]	6/21 - 8/31	50 - 55[2]
Columbia River at McNary Dam[3]	4/10 - 6/30	220 - 260[2]	7/01 - 8/31	200
Columbia River at Priest Rapids Dam	4/10 - 6/30	135	NA	NA
Columbia River at Bonneville Dam	11/1 - emergence	125 - 160[4]	NA	NA

[1] Flow objective values are in thousands of cubic feet per second (kcfs).
[2] Objective varies according to water volume forecasts.
[3] NMFS is contemplating moving the flow measurement location from McNary Dam to Bonneville or The Dalles dam by creating new objectives for Bonneville Dam.
[4] Objective varies based on actual and forecasted water conditions.

The importance of maintaining and restoring mainstem and tributary instream flow for the recovery of listed Snake, Columbia and Willamette River salmonids was strongly reinforced in a document entitled "Conservation of Columbia Basin Fish: Final Basinwide Salmon Recovery Strategy" (Basinwide Recovery Strategy)(Federal Caucus 2000), discussed more fully in section 2.1.3.4, below.

2.1.2.2 Environmental Baseline

The environmental baseline, to which the effects of the proposed action would be added, "include the past and present impacts of all Federal, State, or private activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" 50 CFR 402.02. The biological requirements of the listed ESUs are currently not being met under the environmental baseline. Their status is such that there must be a significant improvement in the environmental conditions of the critical habitat over those currently available under the environmental baseline. Any further degradation of these conditions would have a significant impact due to the amount of risk the listed ESUs presently face under the environmental baseline.

In 1999, the Bureau of Reclamation (BOR) published the final results of a study on the cumulative hydrologic effects of water use on flows in the Columbia Basin (BOR 1999). The purpose of the BOR study was to establish the environmental baseline streamflow conditions in the Columbia Basin before the major human activities that have altered stream flows, to compare these natural conditions to present conditions, and to identify the relative contribution that power and flood control reservoir operations and water withdrawals have made to affect the change from natural to current streamflow conditions.

In the Columbia Basin above McNary Dam, some thirty million acre-feet of water is withdrawn for irrigation annually (BPA 1992). The BOR study estimates that these withdrawals are nearly 40-percent of the average natural river flow in low flow years at McNary Dam during the irrigation season, which coincides with the salmon migration season. The BOR found that water withdrawals for irrigation are the principal reason for missing instream flow objectives, (described above) during most years in the Snake River, and a significant reason for our inability to meet instream flow objectives more often in the Columbia River, especially during summer. Thus, the BOR report confirmed that present hydrologic conditions not properly functioning in the action area and thus are inadequate in many years to meet the biological requirements of listed ESUs. Moreover, according the BOR, additional new water withdrawals could largely neutralize its costly efforts to augment flows by 427,000 acre-feet under the FCRPS biological opinion.[16]

In February 2001, the BCD attributed irrigation reductions of 84,606 acre-inches per year to participation of 1,948 acres in the flow replacement plan described above[17], although that figure overestimates total flow replacement since it does not account for changes in consumptive use and return flows. BCD also calculated a reduction in soil erosion from those same acres of 32,650 tons per year. Despite these improvements, the current status of the 12 ESUs, based upon their risk of extinction, has not significantly improved since the species was listed.

2.1.2.3 Factors Affecting Species' Environment In Action Area

In general, the environment for salmonids in the Columbia Basin, including those that migrate past and downstream of the project site, has been dramatically affected by the development and operation of the FCRPS. Forestry, farming, grazing, road construction, hydrosystem

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[16] Letter from J. Keys III, Regional Director, Bureau of Reclamation, to M. Pagel, Director, Oregon Water Resources Department (January 18, 1996) (referring to concerns previously raised with the Corps of Engineers related to a request by Boeing Agri-Industrial Corp. for water use permit requests).

[17] Email from Scott Manley, Benton Conservation District, to Marc Liverman, National Marine Fisheries Service (February 23, 2001)(transmitting 2000 soil and water spreadsheet).

development, mining, and urbanization have also radically reduced the quantity and quality of historic habitat conditions in much of the basin.

For more than 100 years, hatcheries in the Pacific Northwest have been used to replace natural production lost as a result of the FCRPS and other development, not to protect and rebuild natural populations. As a result, most salmon populations in this region are primarily hatchery fish. The traditional response to declining salmon catches was hatchery construction to produce more fish, thus allowing harvest rates to remain high and further exacerbating the effects of over fishing on the naturally produced (nonhatchery) runs mixed in the same fisheries.

Changes in salmonid populations are also substantially affected by variation in the freshwater and marine environments. Ocean conditions that are a key factor in the productivity of Northwest salmonid populations appear to have been in a low phase of the cycle for some time and are likely an important contributor to the decline of many stocks. The survival and recovery of these species will depend on their ability to persist through periods of low natural survival. Additional details about these effects can be found in Federal Caucus (2000), NMFS (2000), and OPB (2000).

2.1.3 Analysis of Effects

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" 50 CFR 402.02. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

The Corps determined that the proposed action "may affect, [and is] likely to adversely affect" listed species. This determination is based on the fact that the Collector Well No. 2 is hydraulically connected to the Columbia River.

2.1.3.1 Effects of Operating the Collector Well on Critical Habitat

The intended effect of this project is withdrawal of water from the Columbia River. In reviewing this action, the NMFS reviewed the impacts of the pumping operations to determine effects on water quality, water quantity, water temperature, water velocity, and safe passage conditions (without impediment or delay).

2.1.3.1.1 Safe Passage (fish screens)

The seven lateral intake structures for Collector Well No.2 range from 65 to 190-feet in length, are buried approximately 48-feet deep, and are all placed 75 to 100-linear feet from the ordinary high water mark. Thus, the placement of these intakes is such that they do not present a risk to fish passage as addressed by the NMFS juvenile fish screen criteria.[18]

2.1.3.1.2 Water Quality, Quantity, Temperature, Velocity, and Safe Passage

The City proposes to pump water from the Collector Well at a maximum rate of 22.57 cfs. The maximum withdrawal would occur during the summer months when demand on the City's water supply is greatest. The well would be available for year-round use although withdrawals are unlikely during months between November and early spring, when water temperatures are within state quality standards and the probability of meeting flow targets designed to protect redds of mainstem spawning chum from dewatering is high.

Water quality, quantity, temperature, velocity and safe passage are directly or indirectly related to flow. Operation of Collector Well No.2 will reduce the volume or quantity of water flowing past the lateral screens, thus reducing the residual volume of instream flow available to dilute pollutants, increasing the rate of water temperature change, and reducing water velocity. Each of these changes affect migrating juvenile salmonids in many ways, including travel time, and consequently duration of exposure to mortality factors during their journey seaward. Changes in flow, water quality and temperature also affect characteristics of the estuary and near-ocean environment and, through effects on travel time, the timing of the estuary arrival of migrating smolts. The affect of each factor on overall survival likely varies among species and among years.

As described in section 2.1.2, the NMFS has concluded that flow reductions in the Snake and Columbia Rivers are a cause of decline of the 12 listed ESUs considered in this Opinion, and that flow augmentation is an important tool for salmon restoration, especially in low flow years. In other words, the environmental baseline is inadequate with respect to flows, especially in low flow years. To increase the probability of meeting the instream flow objectives, the FCRPS biological opinion the Basinwide Recovery Strategy call for actions that augment flows by placing heavy burdens on upstream storage and other water users. For example, the BOR is providing, through current Federal storage and water acquisition purchased at market rates, 427,000 acre-feet of water for flow augmentation in the Snake River. This water also contributes to flows in the Columbia below McNary Dam. In the Columbia, water is provided from storage projects in the upper Columbia Basin (Canada and Montana) and the mid-Columbia (Grand Coulee in Washington). Moreover, the Basinwide Recovery Plan strongly supports efforts to meet the instream flow objectives, and calls for the purchase of substantial instream flow rights to improve tributary and mainstem habitat conditions.

As noted in section 2.1.2 above, water withdrawals in the Columbia Basin contribute significantly to the inability of the system to meet instream flow objectives, especially in low flow years. As with the FCRPS Opinion, the NMFS cannot pass lightly on actions that historically have contributed so significantly to degrading environmental baseline conditions, but

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[18] MFS Revised Juvenile Fish Screen Criteria, March 23, 1995, and a May 9, 1996, Addendum, Juvenile Fish Screen Criteria for Pump Intakes.

must give them a hard look. Although the total quantity of water the City proposes to withdraw is not, by itself, a significant volume, it diverts an incremental amount that, taken with other actions, has a significant cumulative impact. The cumulative effect of existing withdrawals has already been discussed. If this action were allowed to go forward without the accompanying flow replacement plan, then presumably additional withdrawals could also continue in the future, on the same logic. As the interior Columbia Basin grows and develops it is foreseeable that demand for water will continue to grow as well. Each subsequent withdrawal by itself may have only a small incremental impact, but taken together they may be expected to have a significant impact that would undermine one of the major improvements in habitat conditions and further degrade the environmental baseline.

Despite the fact that the City has a flow replacement plan to achieve "zero net impact" on the instream flow targets, a time lag will necessarily occur between initiation of the proposed new water withdrawal and completion of the flow replacement plan that may reduce the probability of meeting the instream flow objective and result in an adverse effect to listed salmon and steelhead species. NMFS expects this time lag to be relatively brief. Moreover, at the conclusion of the flow replacement plan, the baseline for water quality and flow will show a net improvement. The improvement will be most consistent between the point where replacement flow is added to the river and the point where it is diverted by Collector Well No.2, but may continue downstream to the extent that Collector operations sometimes occur at less than full capacity.

2.1.3.2 Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." Other activities within the watershed have the potential to impact fish and habitat within the action area. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or have been) reviewed through separate section 7 consultation processes.

Between 1990 and 1998, human population in the Columbia Plateau region had a growth rate of 14.4 percent, a pattern very similar to the State's pattern of growth (OPB 2000). Further, Tillamook Creamer Association recently established a new cheese factory in the Boardman area that may induce additional processors to site facilities nearby. Thus NMFS assumes that future private and State actions will continue within the action area, but at increasingly higher levels as population density climbs and agricultural operations expand.

2.1.3.3 Consistency with Basinwide Salmon Recovery Strategy

Step 4 of the evaluation framework ultimately requires that NMFS determine whether the species-level biological requirements can be met considering the significance of the effects of the action under consultation. Recovery planning can provide the best guidance for making this determination.

Recovery planning will identify the feasible measures that are needed in each stage of the salmonid life cycle for conservation and survival within a reasonable time. Measures are feasible if they are expected both to be implemented and to result in the required biological benefit. A time period for recovery is reasonable depending on the time requirements for implementation of the measures and the confidence in the survival of the species while the plan is implemented. The plan must demonstrate the feasibility of its measures, the reasonableness of its time requirements, and how the elements are likely to achieve the conservation and survival of the listed species based on the best science available.

In 1995, NMFS relied on the proposed Snake River salmon recovery plan, issued in draft in March 1995 (NMFS 1995b). Since 1995, the number of listed salmonid species and the need for recovery planning for Columbia Basin salmonids has quadrupled. Rather than finalize the 1995 proposed recovery plan, NMFS has developed guidelines for basin-level, multispecies recovery planning on which individual, species-specific recovery plans can be founded. "Basin-level" encompasses habitat, harvest, hatcheries, and hydro. This recovery planning analysis is contained in the document entitled "Conservation of Columbia Basin Fish: Final Basinwide Salmon Recovery Strategy" (Basinwide Recovery Strategy)(Federal Caucus 2000).

The Basinwide Recovery Strategy replaces the 1995 proposed recovery plan for Snake River stocks until a specific plan for those stocks is developed on the basis of the Basinwide Recovery Strategy. Recovery plans for each individually listed species will provide the particular statutorily required elements of recovery goals, criteria, management actions, and time estimates that are not developed in the Basinwide Recovery Strategy. In the interim, the Basinwide Recovery Strategy identifies immediate actions to prevent extinction and foster recovery by improving survival across all life stages. It emphasizes actions that are currently authorized, that have predictable benefits, and that benefit a broad range of species.

Tributary and mainstem flow restoration are among the foremost actions recommended for the habitat and hydropower components of the Basinwide Recovery Strategy. Fish productivity is the ultimate performance standard for achievement of habitat improvement but is not measurable in the short term. Instead, the Basinwide Recovery Strategy calls for development of a set of performance measures based on associations between ecosystem processes and salmonid populations to create a more immediate gauge of conservation success. Instream flow is one of four habitat factors to be included as part of this performance standard through measures such as increase in stream miles having adequate instream flow and achievement of the instream flow objectives contained in the FCRPS biological opinion. The Federal Caucus agencies anticipate that accomplishing actions described in the habitat element of the Basinwide Recovery Strategy will have significant measurable benefits for listed salmonids and resident fish, including increased cumulative survival and lowered risk of extinction. Thus, actions that are consistent with those called for in the Basinwide Recovery Strategy are also consistent with the Strategy's primary goal of increasing the likelihood of survival and recovery of listed salmonids.

While the species-specific recovery plans are being developed, the Basinwide Recovery Strategy provides the best guidance for judging the significance of an individual action relative to the species-level biological requirements. In the absence of completed recovery planning, NMFS strives to ascribe the appropriate significance to actions to the extent available information allows. Where information is not available on the recovery needs of the species, either through recovery planning or otherwise, NMFS applies a conservative substitute that is likely to exceed what would be expected of an action if information were available.

The proposed action is consistent with the primary objectives of the Basinwide Recovery Strategy. Authorization of the proposed use and replacement flow plan will help to conserve instream flow necessary for the survival and recovery of listed species while minimizing adverse socio-economic and other human effects.

2.1.4 Conclusion

The NMFS has determined that, when the effects of the Corps' proposed action (authorization of the City's use of Collector Well No.2 consistent with the proposed flow replacement plan) are added to the environmental baseline and cumulative effects occurring in the action area, they are not likely to jeopardize the continued existence of the 12 listed ESUs considered in this Opinion. Further, the NMFS concludes that the subject actions would not cause adverse modification or destruction of designated critical habitats for the 12 listed ESUs of Columbia Basin salmonids considered in this Opinion.

These conclusions were based on the following considerations: 1) Intake structures for Collector Well No.2 are buried at a depth that will avoid any risk to fish passage; 2) completion of the flow replacement plan within six years will provide 76,686 acre-inches per year of water for instream use at, or upstream of, the Collector Well during periods when instream flow objectives are not likely to be met, and thus eliminate the potential adverse effects of using the Collector Well to withdraw water from the Columbia River; 3) completion of the flow replacement plan is also expected to result in an improvement over baseline conditions for water quality and flow at the reach level, between the point where replacement flows are added to the river and the point where flow is diverted by Collector Well No.2; 4) the proposed action will not prevent or delay achievement of proper functioning habitat conditions for water quality or flow in the action area; and 5) the proposed action is consistent with expectations of the Basinwide Recovery Strategy. An increase in water depletions not offset by timely flow replacement would undermine this no jeopardy conclusion. In reaching these determinations, NMFS used the best scientific and commercial data available.

2.1.5 Conservation Recommendations

Section 7 (a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid the potential adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, to develop additional information, or to assist the Federal agencies in complying with the obligations under Section 7(a)(1) of the ESA. NMFS has no conservation recommendations to make at this time.

2.1.6 Reinitiation of Consultation

This concludes formal consultation on the City of Boardman Ranney Collector Well Project as outlined in the biological assessment submitted in April 2001. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) The amount or extent of taking specified in the Incidental Take Statement is exceeded, or is expected to be exceeded; 2) new information reveals effects of the action may affect listed species in a way not previously considered; 3) the action is modified in a way that causes an effect on listed species that was not previously considered; or 4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

2.2 Incidental Take Statement

Sections 4 (d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, and sheltering. Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

2.2.1 Amount or Extent of Take

The NMFS anticipates that operation of the City of Boardman's Collector Well No.2 considered in this Opinion has more than a negligible likelihood of resulting in incidental take of the 12 listed ESUs of Columbia Basin salmonids considered in this consultation. Effects of actions such as these are largely unquantifiable and are not expected to be measurable as long-term effects on population levels. Therefore, even though NMFS expects some low level incidental take to occur due to this project, the best scientific and commercial data available are not sufficient to enable NMFS to estimate a specific amount of incidental take to the species itself. In instances such as these, the NMFS designates the expected level of take as "unquantifiable." Based on the information in the biological assessment, NMFS anticipates that an unquantifiable amount of incidental take could occur as a result of the Ranney Collector Well Project considered in this Opinion.

In the accompanying biological opinion, the NMFS determined that this level of anticipated take is not likely to result in jeopardy to the 12 listed ESUs of Columbia Basin salmonids considered in the biological opinion or result in the destruction or adverse modification of critical habitats.

2.2.2 Reasonable and Prudent Measures

The measures described below are non-discretionary. They must be implemented so that they become binding conditions in order for the exemption in section 7(a)(2) to apply. The Corps has the continuing duty to regulate the activities covered in this incidental take statement. If the Corps fails to require the applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. The NMFS believes that activities carried out in a manner consistent with these reasonable and prudent measures, except those otherwise identified, will not necessitate further site-specific consultation. Activities which do not comply with all relevant reasonable and prudent measures will require further individual consultation.

The NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize the likelihood of take of listed fish resulting from implementation of this Opinion. These reasonable and prudent measures would also minimize adverse effects to designated critical habitat.

1. Minimize the likelihood of incidental take from operation of the City's Collector Well No.2 by requiring accomplishment of the flow replacement program.

2. Ensure the effective administration of a replacement flow monitoring and reporting program to ensure this biological opinion is meeting its objective of "zero net impact" on instream flow objectives.

2.2.3 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above for each category of activity. These terms and conditions are non-discretionary.

1. To implement Reasonable and Prudent Measure #1 (flow replacement), above, the Corps shall ensure that the lease shall be conditioned to require accomplishment of the flow replacement program as follows:

    a. The City will provide a quantity of replacement flow equal to that of their new diversion by promoting changes in cropping patterns to reduce water consumption on neighboring farms. The City will accomplish this by providing funds necessary to establish eligibility for a cost-share program known as the Environmental Quality Incentives Program (EQIP), or a comparable conservation program, administered by the Benton Conservation District in Prosser, Washington. Only those reductions in consumptive use that can be ascribed to permanent changes in crop patterns on farms participating in the City’s enhancement of the BCD EQIP program will be credited for purposes of calculating replacement flow quantity.

b. All increases in water availability due to reduced crop water demand on these lands will accrue to flows upstream of the City's proposed new diversion site in the John Day Pool of the Columbia River.

c. The City shall ensure that diversion reduction agreements signed by the irrigation district are part the EQIP contract signed by participating farmers and BCD. BCD will include clauses within each contract specifying the crop conversion condition and the reduced diversion amount.

d. The City shall complete all acts necessary to accomplish crop conversions and provide full replacement flows within six years.

2. To implement Reasonable and Prudent Measure #2 (monitoring and reporting), above, the Corps shall ensure that the lease is conditioned to require the City and BCD to submit a report to the Corps and NMFS every two years. Each report will provide all necessary information to document the net accumulation of irrigation water savings, including the continued production of crops with reduced water demands and diversion reductions by irrigation districts. If reductions in conservation savings or increases in diversions are found, the City shall offset any such change with new or amended EQIP contracts, or otherwise to curtail or cease their own water use as necessary.

The annual report will be submitted to:

National Marine Fisheries Service
Oregon Habitat Branch
Attn: OSB2001-0153
525 NE Oregon Street, Suite 500
Portland, OR 97232

3. MAGNUSON-STEVENS ACT

3.1 Background

The objective of the Essential Fish Habitat (EFH) consultation is to determine whether the proposed action may adversely affect designated EFH for relevant species, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

3.2 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), requires the inclusion of EFH descriptions in Federal fishery management plans. In addition, the MSA requires Federal agencies to consult with NMFS on activities that may adversely affect EFH.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting the definition of essential fish habitat: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50CFR600.110).

Section 305(b) of the MSA (16 U.S.C. 1855(b)) requires that:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;
- NMFS shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH;
- Federal agencies shall within 30 days after receiving conservation recommendations from NMFS provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NMFS, the Federal agency shall explain its reasons for not following the recommendations.

The MSA requires consultation for all actions that may adversely affect EFH, and does not distinguish between actions within EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by Federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of its location.

3.3 Identification of EFH

The Pacific Fisheries Management Council (PFMC) has designated EFH for federally-managed fisheries within the waters of Washington, Oregon, and California. The designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon and California, seaward to the boundary of the U.S. exclusive economic zone (370.4 km)(PFMC 1998a, 1998b). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years)(PFMC 1999). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border.

Detailed descriptions and identifications of EFH for the groundfish species are found in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to The Pacific Coast

Groundfish Management Plan (PFMC 1998a) and the NMFS Essential Fish Habitat for West Coast Groundfish Appendix (Casillas *et al.* 1998). Detailed descriptions and identifications of EFH for the coastal pelagic species are found in Amendment 8 to the Coastal Pelagic Species Fishery Management Plan (PFMC 1998b). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the potential adverse effects to these species' EFH from the proposed action is based on this information.

3.4 Proposed Actions

The proposed action is detailed above in section 1.2. The action area includes encompasses critical habitats from the project location on the Columbia River at approximate River Mile 268.0 downstream to the Pacific Ocean. This area has been designated as EFH for various life stages of groundfish, coastal pelagics, and salmon (Table 1).

3.5 Effects of Proposed Action

As described in detail in section 2.1.3, the proposed activities may result in detrimental short- and long-term adverse effects to a variety of habitat parameters. These impacts include

3.6 Conclusion

NMFS believes that the proposed action may adversely affect the EFH for groundfish, coastal pelagic species, and Pacific salmon species listed in Table 1.

3.7 EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Act, NMFS is required to provide EFH conservation recommendations for any Federal or state agency action that would adversely affect EFH. The conservation measures proposed for the project by the Corps, all Conservation Recommendations outlined above in section 2.1.5 and all of the Reasonable and Prudent Measures and the Terms and Conditions contained in sections 2.2.2 and 2.2.3 are applicable to EFH. Therefore, NMFS incorporates each of those measures here as EFH recommendations.

3.8 Statutory Response Requirement

Please note that the Magnuson-Stevens Act (section 305(b)) and 50 CFR 600.920(j) requires the Federal agency to provide a written response to NMFS after receiving EFH conservation recommendations within 30 days of its receipt of this letter. This response must include a description of measures proposed by the agency to avoid, minimize, mitigate or offset the adverse impacts of the activity on EFH. If the response is inconsistent with a conservation recommendation from NMFS, the agency must explain its reasons for not following the recommendation.

3.9 Consultation Renewal

The Corps must reinitiate EFH consultation with NMFS if either action is substantially revised or new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920).

Table 1. Species with designated EFH found in waters of the State of Oregon.

Groundfish Species	Blue rockfish (*S. mystinus*)	Rougheye rockfish (*S. aleutianus*)	Flathead sole (*Hippoglossoides elassodon*)
Leopard shark (*Triakis semifasciata*)	Bocaccio (*S. paucispinis*)	Sharpchin rockfish (*S. zacentrus*)	Pacific sanddab (*Citharichthys sordidus*)
Soupfin shark (*Galeorhinus zyopterus*)	Brown rockfish (*S. auriculatus*)	Shortbelly rockfish (*S. jordani*)	Petrale sole (*Eopsetta jordani*)
Spiny dogfish (*Squalus acanthias*)	Canary rockfish (*S. pinniger*)	Shortraker rockfish (*S. borealis*)	Rex sole (*Glyptocephalus zachirus*)
Big skate (*Raja binoculata*)	Chilipepper (*S. goodei*)	Silvergray rockfish (*S. brevispinus*)	Rock sole (*Lepidopsetta bilineata*)
California skate (*R. inornata*)	China rockfish (*S. nebulosus*)	Speckled rockfish (*S. ovalis*)	Sand sole (*Psettichthys melanostictus*)
Longnose skate (*R. rhina*)	Copper rockfish (*S. caurinus*)	Splitnose rockfish (*S. diploproa*)	Starry flounder (*Platyichthys stellatus*)
Ratfish (*Hydrolagus colliei*)	Darkblotched rockfish (*S. crameri*)	Stripetail rockfish (*S. saxicola*)	
Pacific rattail (*Coryphaenoides acrolepsis*)	Grass rockfish (*S. rastrelliger*)	Tiger rockfish (*S. nigrocinctus*)	**Coastal Pelagic Species**
Lingcod (*Ophiodon elongatus*)	Greenspotted rockfish (*S. chlorostictus*)	Vermillion rockfish (*S. miniatus*)	Northern anchovy (*Engraulis mordax*)
Cabezon (*Scorpaenichthys marmoratus*)	Greenstriped rockfish (*S. elongatus*)	Widow Rockfish (*S. entomelas*)	Pacific sardine (*Sardinops sagax*)
Kelp greenling (*Hexagrammos decagrammus*)	Longspine thornyhead (*Sebastolobus altivelis*)	Yelloweye rockfish (*S. ruberrimus*)	Pacific mackerel (*Scomber japonicus*)
Pacific cod (*Gadus macrocephalus*)	Shortspine thornyhead (*Sebastolobus alascanus*)	Yellowmouth rockfish (*S. reedi*)	Jack mackerel (*Trachurus symmetricus*)
Pacific whiting (Hake) (*Merluccius productus*)	Pacific Ocean perch (*S. alutus*)	Yellowtail rockfish (*S. flavidus*)	Market squid (*Loligo opalescens*)
Sablefish (*Anoplopoma fimbria*)	Quillback rockfish (*S. maliger*)	Arrowtooth flounder (*Atheresthes stomias*)	
Aurora rockfish (*Sebastes aurora*)	Redbanded rockfish (*S. babcocki*)	Butter sole (*Isopsetta isolepsis*)	**Salmon**
Bank Rockfish (*S. rufus*)	Redstripe rockfish (*S. proriger*)	Curlfin sole (*Pleuronichthys decurrens*)	Coho salmon (*O. kisutch*)
Black rockfish (*S. melanops*)	Rosethorn rockfish (*S . helvomaculatus*)	Dover sole (*Microstomus pacificus*)	Chinook salmon (*O. tshawytscha*)
Blackgill rockfish (*S. melanostomus*)	Rosy rockfish (*S. rosaceus*)	English sole (*Parophrys vetulus*)	

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