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, Washington 98115

Refer to NMFS Tracking
No.: 2007/02301

February 5, 2008

Mike Gearheard, Director
Office of Water and Watersheds
Environmental Protection Agency, Region 10
1200 Sixth Avenue,
Seattle, Washington 98101

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Washington State Water Quality Standards – Environmental Protection Agency's Proposed Approval of Revised Washington Water Quality Standards for Temperature, Intergravel Dissolved Oxygen, and Antidegradation Statewide consultation.

Dear Mr. Gearheard:

The enclosed document contains a biological opinion prepared by the National Marine Fisheries Service pursuant to Section 7(a)(2) of the Endangered Species Act on the effects of the Environmental Protection Agency's proposed approval of revised Washington State water quality standards for designated uses, temperature, dissolved oxygen and other revisions per 40 CFR Part 131. In this biological opinion, the National Marine Fisheries Service concludes that the action, as proposed, is not likely to jeopardize the continued existence of Snake River fall run Chinook, Snake River spring/summer run Chinook, upper Columbia River spring run Chinook, lower Columbia River Chinook, Puget Sound Chinook, Columbia River chum, Hood Canal summer run chum, lower Columbia River coho, Snake River sockeye, Ozette Lake sockeye, Snake River steelhead, upper Columbia River steelhead, middle Columbia River steelhead, lower Columbia River steelhead, and Puget Sound steelhead; or result in the destruction or adverse modification of critical habitat for Snake River fall Chinook, Snake River spring/summer Chinook, upper Columbia River spring Chinook, lower Columbia River Chinook, Puget Sound Chinook, Columbia River chum, Hood Canal summer chum, lower Columbia River coho, Snake River sockeye, Lake Ozette sockeye, Snake River steelhead, upper Columbia River steelhead, middle Columbia River steelhead, and lower Columbia River steelhead.

As required by Section 7 of the Endangered Species Act, an incidental take statement prepared by the National Marine Fisheries Service is provided with the biological opinion. The incidental take statement describes reasonable and prudent measures the National Marine Fisheries Service considers necessary or appropriate to minimize incidental take associated with this action. It also sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal agency and applicant, if any, must comply with to carry out the reasonable and prudent measures. Incidental take from actions by the action agency and applicant that meet these terms and conditions will be exempt from the Endangered Species Act take prohibition.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes one additional conservation recommendation to avoid, minimize, or otherwise offset potential adverse effects on essential fish habitat. The Conservation Recommendation is not identical to the Endangered Species Act Terms and Conditions. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to the National Marine Fisheries Service within 30 days after receiving these recommendations. If the response is inconsistent with the recommendations, the Environmental Protection Agency must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall essential fish habitat program effectiveness by the Office of Management and Budget, the National Marine Fisheries Service established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each essential fish habitat consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the essential fish habitat portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

If you have questions regarding this consultation or need to request confirmation of a conference as a biological opinion, please contact Thom Hooper, Salmon Habitat Conservation Biologist**,** Lacey, Washington, (360) 753-9453, email thomas.hooper@noaa.gov.

Sincerely,

Michael Tehan
for D. Robert Lohn
Regional Administrator

Enclosure

cc: Jay Manning, Ecology
Ken Berg, USFWS

Endangered Species Act – Section 7 Consultation Biological Opinion

And

Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

EPA's Proposed Approval of Revised Washington Water Quality Standards for Designated Uses, Temperature, Dissolved Oxygen, and Other Revisions

Statewide Consultation

Lead Action Agency:	United States Environmental Protection Agency
Consultation Conducted By:	National Marine Fisheries Service Northwest Region
Date Issued:	February 5, 2008
Issued by:	for D. Robert Lohn Regional Administrator
NMFS Tracking No.:	2007/02301

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INTRODUCTION

The Endangered Species Act (ESA) of 1973 (16 U.S.C. § 1531-1544), as amended, establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the Fish and Wildlife Service (Service) and the National Marine Fisheries Service (NMFS, collectively the Services), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. This biological opinion (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.

The analysis also fulfills the essential fish habitat (EFH) requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).

Background and Consultation History

Overview of the Water Quality Standards

A water quality standard (WQS) defines the goals that a given water body should achieve in order to support the existing and designated uses that occur in that water body. This is done by setting criteria necessary to protect the uses and by preventing or limiting degradation of water quality. The Clean Water Act (CWA) as amended (33 U.S.C. § 1251-1376), provides the statutory basis for the WQS program and defines broad water quality goals. For example, section 101(a) states, in part, that wherever attainable, waters shall achieve a level of quality that provides for the protection and propagation of fish, shellfish, wildlife, and for human recreation in and on the water.

Section 303(c) of the CWA requires that all states adopt water quality standards and that the Environmental Protection Agency (EPA) review and approve these standards. In addition to adopting WQS, states are required to review and revise the standards every 3 years. This public process, commonly referred to as the Triennial Review, allows for new technical and scientific data to be incorporated into the standards. The regulatory requirements governing WQS are established at 40 CFR Part 131.

The minimum requirements that must be included in the state standards are: (1) designated uses, (2) criteria to protect the uses, and (3) an antidegradation policy to protect existing uses and water bodies with exceptionally high water quality. In addition to these elements, the regulations allow for states to adopt discretionary policies such as allowances for mixing zones and variances from WQS. These policies are also subject to EPA review and approval.

All standards officially adopted by the state are submitted to the EPA for review and approval or disapproval. The EPA reviews the standards to determine whether the analyses performed are adequate and evaluates whether the designated uses are appropriate and the criteria are protective of those uses. If the EPA determines that the revised or new WQS are not consistent with the CWA, they will disapprove those portions of the WQS that do not meet the requirements. The state is then given an opportunity to make appropriate changes. If the state does not adopt the required changes, EPA must promulgate Federal regulations to replace those disapproved portions.

Section 303 of the CWA requires states and authorized Indian tribes to adopt WQS, including antidegradation provisions consistent with the regulations at 40 CFR 131.12. Under these rules, states and authorized Indian tribes are required to adopt antidegradation policies to provide three levels of water quality protection and identify implementation methods. The first level of protection (Tier 1) requires the maintenance and protection of existing instream water uses and the level of water quality necessary to protect those existing uses. Existing uses are defined as: A...those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the WQS.@ 40 CFR 131.3(e). The second level of protection (Tier 2) is for high quality waters, which are waters where the quality is better than the levels necessary to support propagation of fish, shellfish, wildlife, and recreation. This high quality water must be protected unless, through a public process, some lowering of the water quality is deemed necessary to accommodate important economic or social development. The third and highest level of protection (Tier 3) is for Outstanding National Resource Waters (ONRWs). If a state or authorized tribe determines that the characteristics of a water body constitute an ONRW, and designates the water body as such, then those characteristics must be maintained and protected.

In addition to requiring states and authorized Indian tribes to have an antidegradation policy, 40 CFR 131.12 requires that implementation methods be identified. Such methods are not required to be contained in the state=s regulation, but are subject to EPA review. The EPA=s regulations provide a great deal of discretion to states and tribes regarding the amount of specificity required in antidegradation implementation methods. The regulations do not specify minimum elements for such methods, but do require that such methods are consistent with the intent of the antidegradation policy. The antidegradation policy only applies to point sources.

Consultation History

The Washington State Department of Ecology (Ecology) completed a Triennial Review of the State's water quality standards in June 2003 and submitted revised standards for water temperature, dissolved oxygen, and policy on antidegradation to EPA Region 10, for approval under the CWA on July 28, 2003. The new standards also changed from a class-based approach to a use-based system.

Upon Ecology's submittal of the new standards to EPA, the Tribes, and the Services expressed concerns to Ecology and EPA. The Tribes and the Services did not believe that the new temperature standards would adequately protect the designated uses. In particular, concerns were raised about the adequacy of the standards to protect salmon and trout spawning, incubation, and rearing.

In light of NMFS's tribal trust and resource responsibilities, the statewide breadth of the proposed action is extensive. Fifteen Evolutionarily Significant Units (ESUs) of salmon and Distinct Population Segments (DPSs) of steelhead and three species of marine mammal DPSs are affected by the proposed action. The salmon and steelhead are likely to be adversely affected. The three marine mammal species, Steller sea lions, Southern resident killer whales, and humpback whales, may experience some affects, but are not likely to be adversely affected by the proposed action. The effects on the three marine mammal species will be discountable or insignificant because the standards addressed in this consultation primarily affect freshwater. The expected numbers of salmon or steelhead that could be adversely affected by the proposed action and that could be prey for marine mammals are immeasurable and likely very few in any one ESU or DPS.

The notable events related to the history of this consultation are summarized below:

- January 3, 2003 – Ecology released draft Water Quality Rule for public comment.
- March 3, 2003 – NMFS sent a letter to Ecology commenting on proposed changes to the State's Surface Water Quality Standards (WQS). NMFS was concerned that the proposed standards for temperature, dissolved oxygen, and ammonia were not protective enough for salmon and steelhead. NMFS also had comments and questions related to the proposed antidegradation policy in the standards.
- June 25, 2003 – Ecology adopted the new WQS and submits the Proposed Final Rule (Rule) to EPA for approval on July 28, 2003.
- November 12, 2003 – The Services attended a meeting with the Northwest Indian Fish Commission Environmental Policy Group to discuss the Rule with EPA. The Services and tribal representatives expressed concerns over the adequacy of the proposed standards to protect fish. The new Rule was a simple conversion from the old class-based system to a use-based system and no standards were revised to match existing fish distribution and use. The EPA agreed that the new Rule did not adequately protect salmonids.

- From December 2003 to August 2004, the Services met with EPA and Ecology to discuss approaches and data requirements necessary to revise and correct the Rule to protect existing aquatic life uses.

To better understand fish use and fish life-history information by watershed and to facilitate Government to Government communication, a number of meetings were organized with the Puget Sound area Tribes. Participants included the Services, the Washington Department of Fish and Wildlife (WDFW), and EPA. In addition to obtaining valuable information on salmonid run-timing and abundance from tribal biologists, the meetings provided the Services an opportunity to listen to other tribal issues regarding the proposed Washington State WQS.

- October 13, 2004 – The Services and EPA met with North Sound Tribes including the Nooksack, Lummi, Stillaguamish, and Tulalip Tribes. The tribal biologists expressed concerns over the adequacy of temperature standards to protect spawning and incubation that occurs in the mainstem and lower tributaries. Surveys of adult fish are often difficult in the larger rivers and visibility is poor in glacial rivers.

- October 14, 2004 – The Services, WDFW, and EPA met with Skagit System Cooperative Tribes and Upper Skagit Tribe. Similar concerns were expressed from the October 13 meeting and questions were raised about the marine standards and why they were not also being addressed by Ecology.

- October 27, 2004 – The Services, WDFW, and EPA met with the Suquamish and Nisqually Tribes. Concerns relating to the marine standards and antidegredation were brought up at all of the other tribal meetings.

- October 28, 2004 – The Services, WDFW, and EPA met with Squaxin, Puyallup and Muckleshoot Tribes. Marine issues were particularly important to this Tribe, and concerns were raised that the existing standards do not adequately address human consumption levels for fish and shellfish.

- November 2, 2004 – The Services, WDFW, and EPA met with Quileute, Makah, and Hoh Tribes. Discussion focused primarily on getting the 16° C temperature standard for the Dickey River based on juvenile salmonid rearing and density. The biologist for the Hoh Tribe also provided temperature and fish distribution information.

- November 8, 2004 – The Services, WDFW, and EPA met with Jamestown, Lower Elwha, and Port Gamble Tribes. Concerns were raised that marine standards were not being addressed, in addition to discussions about allowable degradation associated with removal of dams, rechannelizing Jimmycomelately Creek, and restoring flows in the Dungeness River. The Tribes believed that the proposed standards needed to address those efforts.

- December 7, 2004 – Last meeting with west side Tribes. The Services, WDFW, and EPA met with the Chehalis and Quinault Tribes.

- January 22, 2005 – The EPA completed review of portions of the 2003 revisions to the WQS regulations and sent an approval letter to Ecology for many of the revisions. The EPA withheld taking action on the remainder of the provisions in Ecology's WQS regulations and spent the rest of the year working with the Services, Tribes, and WDFW to revise the application of the temperature standards. Region by region the Services and EPA listened to local Tribes and WDFW biologists to understand salmon distribution and spawning in the local watershed. The Services and EPA also used WDFW's salmon distribution database. Combined this exercise generated a set of maps depicting applicable temperature's supportive of known salmon and trout use. A pair of maps was generated for each Water Resource Inventory Area (WRIA) in the state.

- Late in 2005, the EPA worked with eastern Washington Tribes to obtain data on salmon distribution and run timing for eastside watersheds. This information was passed on to the Services in subsequent meetings.

- On March 22, 2006, the EPA and the Services completed a review of specific aquatic life designated uses and associated temperature criteria. After reviewing the available fish distribution information, EPA determined that some streams had incorrect aquatic life use designations and some streams had temperature criteria that were not protective of the appropriate fish uses in the streams. Based on this review, EPA disapproved the aquatic life designated use and associated temperature criteria for specific water bodies in Washington.

- In June 2006, Ecology proposed revised WQS to address EPA's March 2006 disapproval action. Ecology revised their WQS in a new rule that was adopted on November 20, 2006. The new standards were submitted to the EPA for approval on December 8, 2006. The EPA is proposing to approve those provisions of the standards that are contained in Washington's 2003 WQS revisions for which EPA has not yet provided a determination. The EPA is also proposing to approve the revised WQS contained in Washington's 2006 standards revisions.

- In December 2004, EPA posted GIS maps on its website. During much of 2005, the Services assisted EPA in review of draft GIS maps depicting spawning and proposed temperature criteria for each WRIA.

- On March 22, 2006, EPA presented a formal disapproval letter to Ecology.

- On July 2006, the Services worked with EPA to resolve proposed temperature standards and steelhead and char issues raised by other Federal agencies in the Yakima and Walla Walla watersheds and other areas in eastern Washington.

- The EPA received Ecology's WQS revisions on August 1, 2006.

- August 7-15, 2006 – The Services and EPA assisted Ecology in a series of public workshops and hearings around the State to discuss required changes to the rule and to solicit public comment. Meetings were held in Mount Vernon, Lacey, Ellensburg, and the Tri Cities.
- December 21, 2006 - Ecology finalized the rule incorporating the required changes and submitted the new package to EPA for approval.
- January, 2008 – Ecology letter to EPA and the Services describing Ecology's approach to making changes (if necessary) to the "special temperature" criteria.

A recent consultation with EPA over the State of Oregon's water quality standards included a conservation measure that required the EPA to establish and lead a regional effort to review temperature requirements of critical life stages of salmonids native to the Pacific Northwest and develop guidance recommending temperature criteria for States and Tribes. The project, termed the Northwest Temperature Criteria Project, was a collaborative process among representative state agencies from Idaho, Oregon, and Washington, Tribes, EPA, and the Services. The final guidance document, entitled EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards (EPA 2003), was completed in March 2003 and will be referred to as the "Temperature Guidance" within the context of this document. NMFS has endorsed the Temperature Guidance and considers it to include the best available scientific information on the thermal requirements of salmon and steelhead and on how to establish state or tribal water quality criteria for temperature.

The Temperature Guidance was referred to numerous times among the Services, EPA, WDFW, Ecology, and Tribes in Washington State in developing the revisions to the Washington State water quality criteria.

Description of the Proposed Action

The proposed action is the EPA's approval of Ecology's revised WQSs. While there were numerous revisions to the WQSs, EPA is seeking consultation on a subset of the WQS. This Opinion examines the effects to listed species from changes proposed to freshwater aquatic life temperature criteria, freshwater aquatic life dissolved oxygen criteria, freshwater aquatic life total dissolved gas criteria, and the antidegradation implementation policy. A draft biological evaluation (BE) was sent to the Services for review on January 25, 2007. The Service submitted comments on the draft to EPA on February 21, 2007. The final BE and request for section 7 consultation was received by NMFS on April 11, 2007. Table 1 lists species that occur in Washington State (as discussed above, marine species are not included in this opinion because revisions to the standards substantially only apply to freshwater).

The specific portions of the Washington State Administrative Rules that EPA proposes to approve include the following (for freshwater aquatic life only): definitions (WAC-173-201A-020); designated uses (WAC 173-201A-200(1)(a), WAC 173-201A-600(1), and

WAC 173-201A-602, except for the *special temperature criteria*[1] for portions of the Columbia, Snake, Yakima, Walla Walla, Skagit, Palouse, Pend Orielle, and Spokane rivers); numeric temperature criteria (WAC 173-201A -200(1)(c)); narrative spawning temperature criteria (WAC 173-201A -200(1)(c)(i), (ii)(A), (iv), and (v)); *interim* numeric dissolved oxygen (DO) criteria (WAC 173-201A-200(1)(d))[2]; special fish passage exemption for the Snake and Columbia rivers (WAC 173-201A -200(1)(f)(ii)); and, natural and irreversible human conditions (WAC-173-201A-260(1)(a)).

A complete copy of the WQS is included in the BE and the administrative record. The following are descriptions of the rules that EPA proposes to approve, as taken from EPA's BE.

Table 1. Status of species listed under the ESA located within the State of Washington; and list of ESUs and DPSs covered in this Opinion**.**

Species	**ESU or DPS**	**ESA Status**	**Federal Register Notice of listing**	
Chinook Salmon (*Oncorhynchus tshawytscha*)	Snake River Fall Run[a]	Threatened	57 FR 14653	04/22/92
	Snake River Spring/Summer Run[a]	Threatened	57 FR 14653	04/22/92
	Upper Columbia River Spring Run[a]	Endangered	64 FR 14308	03/24/99
	Lower Columbia River[a]	Threatened	64 FR 14308	03/24/99
	Puget Sound[a]	Threatened	64 FR 14308	03/24/99
Chum Salmon (*Oncorhynchus keta*)	Columbia River[a]	Threatened	64 FR 14508	03/25/99
	Summer run -Hood Canal[a]	Threatened	64 FR 14528	03/25/99
Coho Salmon (*Oncorhynchus kisutch*)	Lower Columbia River	Threatened	70 FR 37160	06/28/05
Sockeye Salmon (*Oncorhynchus nerka*)	Snake River[a]	Endangered	56 FR 58619	11/20/91
	Ozette Lake[a]	Threatened	64 FR 14528	03/25/99
Steelhead (*Oncorhynchus mykiss*)	Snake River[a]	Threatened	62 FR 43937	08/18/97

[1] EPA is not taking action on the special temperature criteria applied in these river segments; however, EPA is approving the designated use changes to these river segments. As discussed in the Effects Analysis section below, the standards applied in these river segments – as special temperature criteria – are incongruous with the designated use.

[2] Ecology is conducting a two year study to determine if the 9.5mg/L DO criteria, as measured in the water column, will provide the minimum 8.0 mg/L needed for salmonid egg incubation and early development in the gravel. Studies conducted by EPA have indicated that there is an average reduction of 3mg/L between the water column and the gravel where eggs are incubating. Depending on the results of the Ecology study, which are expected in 2008, the DO standards for Washington may need to be increased to ensure that the 8mg/L intergravel dissolved oxygen level (IGDO) is achieved. This will require a Rule Revision and may trigger re-initiation of this consultation.

Species	ESU or DPS	ESA Status	Federal Register Notice of listing	
	Upper Columbia River[a]	Endangered	62 FR 43937	08/18/97
	Middle Columbia River[a]	Threatened	64 FR 14517	03/25/99
	Lower Columbia River[a]	Threatened	63 FR 13347	03/19/98
	Puget Sound	Threatened	72FR 26722	05/11/07

Description of Specific Standards Proposed for Approval

The 7-day average of the daily maximum temperatures (7-DADMax) is the arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day=s daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

Fresh Water Aquatic Life Uses

All indigenous fish and nonfish aquatic species must be protected in waters of the state in addition to the key species described below.

(a) The categories for aquatic life uses are:

(i) Char spawning and rearing. The key identifying characteristics of this use are spawning or early juvenile rearing by native char (bull trout and Dolly Varden), or use by other aquatic species similarly dependent on such cold water. Other aquatic life uses for waters in this category include summer foraging and migration of native char; and spawning, rearing, and migration by other salmonid species.

(ii) Core summer salmonid habitat. The key identifying characteristics of this use are summer (June 15 – September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and subadult native char. Other aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids.

(iii) Salmonid spawning, rearing, and migration. The key identifying characteristic of this use is salmon or trout spawning and emergence that occurs outside of the summer season (September 16 – June 14). Other aquatic life uses for waters in this category include rearing and migration by salmonids.

(iv) Salmonid rearing and migration only. For the protection of rearing and migration of salmon and trout, and other associated aquatic life.

(v) Non-anadromous interior redband trout. For the protection of waters where the only trout species is a non-anadromous form of self-reproducing interior redband trout (*O. mykiss*), and other associated aquatic life.

(vi) Indigenous warm water species. For the protection of waters where the dominant species under natural conditions would be temperature tolerant indigenous non-salmonid species. Examples include dace, redside shiner, chiselmouth, sucker, and northern pikeminnow.

Freshwater Aquatic Life Temperature Criteria

Ecology has changed the metric for measuring water temperature. The old standard was applied to each day, so that if a water body exceeded the standard on any given day, that water body would be placed on the State's 303(d) list of impaired water bodies. The proposed standard measures water temperature based on a 7-day average of the daily maximum temperatures (7-DADMax). In addition, the temperature criteria were changed as indicated in Table 2.

Table 2. Aquatic life temperature criteria.

Aquatic Life Temperature Criteria in Freshwater		
Aquatic Use Category	**New 7-DADMax**	**Old 1-Day Maximum**
Char Spawning	9° C (48.2° F)	16° C (Class AA)
Char spawning and rearing	12° C (53.6° F)	16° C (AA)
Salmon and trout spawning	13° C (55.4° F)	16° C / 18° C (AA/A)
Core Summer salmonid habitat	16° C (60.8° F)	16° C / 18° C (AA/A)
Salmonid spawning, rearing and migration	17.5° C (63.5° F)	18° C
Salmonid rearing and migration only	17.5° C (63.5° F)	18° C
Non-anadromous Interior Redband Trout	18° C (64.4° F)	18° C
Indigenous Warm Water Species	20° C (68° F)	21° C

When a water body's temperature is warmer than the criteria in Table 2 above (Table 200 (1)(c) in Ecology's Water Quality Standards), or within 0.3° C (0.54° F) of the criteria, and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3° C (0.54° F).

When the background condition of the water is cooler than the criteria in Table 2 (Table 200 (1)(c) in Ecology's Water Quality Standards), the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows:

Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 28° C/(T+7) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);

To protect spawning and incubation of salmon and steelhead, Ecology has identified water bodies, or portions thereof, which require special protection for spawning and incubation in Ecology publication 06-10-038 (also available on Ecology's web site at www.ecy.gov). This publication indicates where and when the following criteria are to be applied to protect the reproduction of native char, salmon and steelhead:

$ Maximum 7-DADMax temperatures of 9E C (48.2E F) at the initiation of spawning and at fry emergence for char; and

$ Maximum 7-DADMax temperatures of 13E C (55.4E F) at the initiation of spawning for salmon and at fry emergence for salmon and steelhead.

For lakes, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3° C (0.54° F) above natural conditions.

Ecology converted waters classified as Lake Class and Class AA waters under the old 1997 rules that were not assigned a "Char" use designation to "Core Summer Salmonid Habitat." Although this simple conversion of the class-based waters to use-based waters adequately assigned many Washington streams to the use of "Core Summer Salmonid Habitat," some waters were not accurately identified with this method. The EPA conducted an analysis of fish distribution data to identify other water bodies that warranted the application of 16° C criterion based on use by rearing salmonids. The process used by EPA is thoroughly discussed in EPA's partial disapproval letter (Appendix D of EPA's BE) and is summarized below.

The EPA analyzed available fish information documenting the types of salmonid uses by life history phase in Washington State. The EPA assessed this information for five general fish presence categories where the Temperature Guidance recommends applying a "Core Summer Salmonid Habitat" use designation and a 16° C. These use factors are:

1. moderate-to-high density *summer* juvenile salmon rearing,
2. *summer* salmon/steelhead spawning or incubation,
3. *summer* adult/sub-adult bull trout foraging and migration,
4. *summer* juvenile rearing with current stream temperatures at or below 16° C,
5. potential to support moderate-to-high density *summer* juvenile rearing that is important for the recovery of salmonids.

The information used for this analysis were databases available from WDFW. These databases contain salmon/steelhead distribution and spawning timing data. The WDFW databases do not contain information documenting the timing/location of summer juvenile salmon rearing and summer adult/sub-adult bull trout foraging and migration. Therefore, EPA could not directly determine which streams should be designated for these two uses from WDFW databases. Besides the WDFW databases, a thorough solicitation for additional information from Indian Tribes and local biologists was conducted to rectify any gaps or omissions in these databases. A summary of this additional information and the associated cited literature are in Appendix D of EPA's BE and in Appendices C and D of EPA's partial disapproval letter.

The EPA determined that where the WDFW database indicated that stream reaches had summer salmon/steelhead spawning or incubation, this indicated that other important fish uses likely occur in these streams during summer (e.g. adult holding, juvenile rearing, char foraging and migration). The EPA concluded that the areas depicted as summer salmon/steelhead spawning or incubation in the WDFW database should be assigned the "Core Summer Salmonid Habitat" designated use and should be protected with a 16° C summer maximum criterion.

The rationale for designating streams with summer salmon spawning or steelhead incubation as "Core Summer Salmonid Habitat" use, with an associated 16°C temperature criterion, is summarized below.

1. Adult Chinook, pink, sockeye, and chum salmon runs that begin spawning in the summer (i.e., mid-September or earlier) are present at the spawning grounds days to weeks, or sometimes months (e.g., spring Chinook) prior to the onset of spawning. These holding adult salmon prefer summer maximum temperatures at or below 16°C with declining temperature prior to spawning to protect the adults from disease and maintain the viability of developed gametes (after ovulation in females and after sperm maturation in males) (McCullough et al. 2001). This period prior to spawning essentially straddles the period of declining temperatures from 16° C to those temperatures protective of the spawning (13° C).

2. Salmon stocks need daily maximum temperatures to decrease to 13°C during the time of spawning for survival and growth of eggs (Temperature Guidance Issue Paper 5 – Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids pages 30-38, McCullough et al. 2001). Based on a review of the temperature patterns in Washington, streams with a 17.5°C summer maximum temperature are unlikely to cool to 13°C maximum temperatures by mid-September, while streams with a 16°C summer maximum temperature are more likely to cool to 13°C maximum temperatures by mid-September (Ecology, March 2005, unpublished data). Therefore, salmon stocks that begin spawning in mid-September or earlier are unlikely to be protected by a 17.5° C summer maximum criterion.

3. Incubating steelhead eggs need maximum temperatures at or below 13° C through the final stages of egg incubation and fry emergence for good survival and growth (McCullough et al. 2001). Based on a review of the temperature patterns in Washington, streams with a 17.5°C summer maximum temperature are unlikely to have 13°C maximum temperatures needed to protect egg incubation at the end of June, while those rivers with a 16°C summer maximum temperature are more likely to have 13° C maximum temperatures at the end of June (Ecology, March 2005). Steelhead stocks that

end spawning in early June will likely have many eggs in the final stages of incubation and fry emerging in late June. Steelhead eggs generally incubate in the gravels for 5-7 weeks. Time to emergence is also influenced by the well-known relationship between temperature and embryonic development, where the rate of development is faster in warmer water (Quinn 2005).

A review of site-specific spawning and redd information indicates that steelhead stocks that end spawning in early June (according to WDFW's Salmon Stock Identification [SaSI] Database) will typically have a substantial portion of spawning activity in mid to late May and occasionally have a few fish that spawn in early June. With the 5-7 week incubation period, steelhead stocks where the SaSI database indicates spawning ends in early June (and thus most spawning occurs in May), will likely have a substantial number of eggs in the final stages of incubation and fry emerging into late June because most of the spawning occurred in May. Some of these fry emerge into July.

4. Salmon fry emerge from the gravel over several months, from late winter into spring (and into the summer for steelhead). These juveniles begin rearing near where they emerged from the spawning grounds. Some juvenile Chinook and all steelhead rear over the summer during their first year of life. The waters in the vicinity of the salmon/steelhead spawning areas are important initial rearing areas for these juveniles and often have relatively moderate-to-high density juvenile rearing use throughout the summer.

The EPA applied the interpretation to the WDFW database that stream reaches depicted by WDFW as either (1) salmon spawning beginning in mid-September or earlier *or* (2) steelhead spawning ending in early June or later, should be designated as "Core Summer Salmonid Habitat" use and protected with a 16° C temperature criterion.

There are several situations where EPA relied on site-specific information, which resulted in exceptions to EPA's general approach of relying on WDFW's databases for determining where the "Core" use designation is appropriate. In some situations, the WDFW databases did not show summer salmon/steelhead spawning or incubation, but EPA did make a "Core" use determination based on one or more of the other factors listed previously. In other situations, the WDFW databases showed summer salmon/steelhead spawning or incubation, but EPA did *not* make a "Core" use determination. Details of these specific determinations are explained in EPA's partial disapproval letter contained in Appendix D of EPA's BE.

The EPA determined that tributaries that drain into water bodies that EPA identified as needing the "Core Summer Salmonid Habitat" use and 16° C criterion should also have the "Core" use designation. The reason for the extension of the use upstream is to ensure that the downstream reaches attain the 16° C criterion necessary to support their "Core" use designation. This is consistent with Ecology's approach for tributaries (see WAC 173-201A-600(1)). The only exceptions to this convention are in the lower elevation portion of several rivers. The EPA determined that it is not necessary for all tributaries to these river segments to have a 16° C criterion, unless summer salmon/steelhead spawning or incubation occurs in the tributary. This applies to tributaries to: (1) the lower portions of the Nooksack, Skagit, Snohomish, Stillaguamish, Nisqually, and Klickitat rivers; and (2) the lower portion of four tributaries to the upper Yakima River (Teanaway River, Swauk Creek, Taneum Creek, and Manastash Creek). These lower elevation rivers are unique, because EPA has determined that they should be "Core" use to (or nearly to) the mouth, and that they are glacially fed or drain mountainous regions. The EPA believes that a few relatively low flow tributaries with a 17.5° C criterion in the lower downstream portion of these rivers will have a negligible impact on attaining the river's "Core" use designation.

Ecology concurred with the methods used by EPA to apply the 16° C criterion to the specified waters of the State and adopted the results of this analysis into their water quality standards. The waters with the 16° C criterion are shown on maps (website: http://www.ecy.wa.gov/pubs/0610038/start.pdf.) and are listed in Table 602 of the Ecology Rule.

Interim Freshwater Aquatic Life Dissolved Oxygen Criteria

The new DO criteria are presented in Table 3 below.

Table 3. Proposed freshwater aquatic life dissolved oxygen criteria.

Aquatic life dissolved oxygen criteria		
Use Category	Proposed Standard Lowest 1-day Minimum	Old Standard
Char	9.5 mg/L	Class AA, 9.5 mg/L
Core summer salmonid habitat	9.5 mg/L	Class AA, 9.5 mg/L; Class A, 8.0 mg/L
Salmonid spawning, rearing and migration	8.0 mg/L	Class A, 8.0 mg/L

General provisions of the DO standard for Washington that have been revised from the old rule include:

> (i) When a water body's DO is lower than the criteria in Table 200(1)(d) (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the DO of that water body to decrease more than 0.2 mg/L.
>
> (ii) For lakes, human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural conditions.

According to the BE, EPA is proposing to approve several areas where the criteria was changed from 8.0 mg/L DO for char, salmon and steelhead to 9.5 mg/L DO (old Class A water designation upgraded to support new designated use criteria). The EPA is also proposing to approve the 9.5 mg/L DO criteria for water bodies with a new Core summer habitat use designation that were previously designated Class A. The EPA is proposing to approve the 8.0 mg/L for two small water bodies with a new salmon spawning, rearing, and migration use designation (Palouse River in Water Resource Inventory Area (WRIA) 34 and Mill Creek in WRIA 32).

Total Dissolved Gas Criteria

This is a special fish passage exemption applied to the Snake and Columbia rivers when spilling water at dams is necessary to aid fish passage.

The criterion reads as follows:

> The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:
>
> > The Total Dissolved Gas (TDG) must not exceed an average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one hundred twenty percent as measured in the tailraces of each dam (these averages are measured as an average of the 12 highest consecutive hourly readings in any one day, relative to atmospheric pressure); and
> >
> > A maximum TDG one hour average of one hundred twenty-five percent must not be exceeded during spillage for fish passage.

Natural Conditions and Other Water Quality Criteria and Applications

Natural and Irreversible Human Conditions

This section of the proposed standards recognizes that portions of many water bodies cannot meet the assigned criteria due to the natural conditions of the water body. When a water body does not meet its assigned criteria due to natural climatic or landscape attributes, the natural conditions constitute the water quality criteria.

Procedures for Applying Water Quality Criteria

In applying the appropriate water quality criteria for a given water body, the new standards allow Ecology to use the following procedure:

> Upstream actions must be conducted in manners that meet downstream water body criteria. Except where and to the extent described otherwise in the standards, the criteria associated with the most upstream uses designated for a water body are to be applied to headwaters to protect non-fish aquatic species and the designated downstream uses.

Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criterion for each parameter is to be applied.

Use Designations in Fresh Water

All surface waters of the state not named in Table 602 of the new Water Quality Standards (Table 602 contains life use designations applied to water bodies in Washington) are to be protected for the designated uses of: salmon and trout spawning, salmonid spawning, rearing, and migration, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and, aesthetic values.

Additionally, the following waters are also to be protected for the designated uses of salmon and trout spawning, core rearing, and migration; and extraordinary primary contact recreation:

(i) All surface waters lying within national parks, national forests, and/or wilderness areas;

(ii) All lakes and all feeder streams to lakes (reservoirs with a mean detention time greater than fifteen days are to be treated as a lake for use designation);

(iii) All surface waters that are tributaries to waters designated salmon and trout spawning, core rearing, and migration; or extraordinary primary contact recreation; and

(iv) All fresh surface waters that are tributaries to extraordinary quality marine waters.

Proposed Conservation Measures

Under section 7(a)(1) of the Endangered Species Act, Federal agencies shall utilize their authorities in furtherance of the purposes of the Endangered Species Act, including the conservation of endangered and threatened species. The EPA has determined that the conservation measures described below are in furtherance of the goal of conserving endangered and threatened species and are part of EPA's action analyzed in this opinion.

1. Dissolved Oxygen Criteria - Ecology has committed to review their DO criteria and initiate rulemaking to revise the standards to 11 mg/L by July 2008, unless they can demonstrate that the current 9.5 mg/L criteria will not lead to adverse effects to incubating salmonid eggs.
2. Triennial Review and Updates – The EPA will ensure that new information on fish distribution and use (migration and timing and location of spawning and rearing) that would result in a change in the designated or existing use and/or application of the spawning narrative criteria are addressed at the following Triennial Review. Ecology has indicated that minor changes to the standards to

protect existing aquatic life uses may not require rule-making and will be addressed as new information becomes available.

Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402). The action area of this consultation consists of all surface waters of the State of Washington for which revised standards have been proposed. The revised WQS apply to all freshwater surface waters of the state, which includes all lakes, ponds, impounding reservoirs, springs, rivers, streams, creeks, marshes, and canals within the territorial limits of the State of Washington, and all other bodies of surface water, natural or artificial, public or private (except those private waters which do not combine or affect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction. The EPA=s approval action does not apply to, and thus the action area does not include, any waters within Native American Country (tribal reservations) or the marine environment.

Most life history stages for ESA-listed salmon and steelhead in Washington State are present within the action area of this consultation. The action area consists of all freshwater of the State of Washington for which:

(1) new numeric and narrative temperature criteria have been proposed;

(2) the numeric dissolved oxygen criterion has changed as a result of the aquatic life use designation changes (e.g., those waters that Ecology is re-designating to address EPA's March 2006 disapproval letter); and

(3) the total dissolved gas exemption applies for fish passage (the Snake and Columbia Rivers).

The action area contains many waters designated as EFH pursuant to the MSA. Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for Federally-managed fisheries within the waters of Washington, Oregon, and California. 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)). Freshwater EFH for Pacific salmon, as described by the PFMC (2000) 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, and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). 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 are contained in the fishery management plans for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998), and Pacific salmon (PFMC 1999). Assessment of the potential adverse effects to these species' EFH from the proposed action is based, in part, on these descriptions and on information provided by the EPA.

ENDANGERED SPECIES ACT

The ESA establishes a national program to conserve threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with FWS, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats.

Biological Opinion

This Opinion presents NMFS's review of the status of each listed species of Pacific salmon and steelhead[3] considered in this consultation, the condition of designated critical habitat, the environmental baseline for the action area, all of the effects of the action as proposed, and cumulative effects (50 CFR 402.14(g)). For the jeopardy analysis, NMFS analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of the survival and recovery of the affected listed species.

The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated critical habitat for listed species by examining any change in the conservation value of the essential features of that critical habitat. The regulatory definition of "destruction or adverse modification" at 50 CFR 402.02 is not used in this Opinion. Instead, this analysis relies on statutory provisions of the ESA, including those in section 3 that define "critical habitat" and "conservation," in section 4 that describe the designation process, and in section7 that sets forth the substantive protections and procedural aspects of consultation, as well as on agency guidance for application of the "destruction or adverse modification" standard.[4]

Status of the Species

NMFS describes the status of the species in terms of the attributes associated with viable salmonid populations (VSP). Viable salmonid populations are populations that have a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame.

NMFS reviews the range-wide status of the species affected by the proposed action using criteria that describe VSP (McElhaney et al. 2000). A viable population has levels of abundance, productivity, spatial structure, and genetic diversity, which enhance its capacity to adapt to various environmental conditions and allow it to become self-

[3] "An ESU of Pacific salmon (Waples 1991) and a DPS of steelhead (final steelhead FR notice) are considered to be 'species,' as defined in section 3 of the ESA."
[4] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

sustaining in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, characteristics that are influenced in turn by habitat and other environmental conditions.

Table 4 lists the 15 ESUs and DPSs of Pacific salmon and steelhead, and their designated critical habitat addressed in this consultation. The current status of each species in Table 4 indicates that the species-level biological requirements currently are not being met for any of the ESUs or DPSs considered in this consultation. This indicates that improvements in survival rates (assessed over the entire life cycle) will be needed to meet species-level biological requirements in the future. NMFS will assess survival improvements necessary in the life stages influenced by the proposed action after considering the environmental baseline, which is specific to the area affected by the proposed action.

The following describes the major habitat limiting factors affecting VSP criteria for each ESU or DPS covered in this consultation. Most of the ESUs and DPSs are composed of several major population groups (MPG) that each have at least two independent populations of salmonid.

Snake River Fall Chinook

Snake River fall-run Chinook spawn above Lower Granite Dam in the mainstem Snake River and in the lower reaches of the larger tributaries. Adult Snake River fall-run Chinook salmon enter the Columbia River in July and August. Spawning occurs from October through November. Juveniles emerge from the gravels in March and April of the following year, moving downstream from natal spawning and early rearing areas from June through early fall.

The NMFS Biological Review Team (BRT) recently completed a status review of Snake River fall-run Chinook salmon and concluded that the species is "likely to become endangered" (Goode et al. 2005). The BRT found moderate risk to the species for productivity and moderately high risks for abundance, spatial structure, and diversity. The paragraphs below summarize information from BRT, Interior Columbia Basin Technical Recovery Team (ICBTRT), and other sources on the status of Snake River fall-run Chinook salmon in terms of those four viability components.
The ICBTRT has defined only one extant population for the SR fall-run Chinook salmon, the Lower Snake River mainstem population. This population occupies the Snake River from its confluence with the Columbia River to Hells Canyon Dam, and the lower reaches of the Clearwater, Imnaha, Grande Ronde, Salmon, and Tucannon Rivers (ICBTRT 2003).

The BRT concluded that, although Snake River fall Chinook salmon numbers have been increasing in recent years[5], there remains a moderately high risk of extinction due to

[5] The Snake River component of the fall Chinook run has been increasing during the past few years as a result of hatchery and supplementation efforts in the Snake and Clearwater River basins. In 2002, more than 15,200 fall Chinook were counted past the two lower dams on the Snake River, with about 12,400

insufficient abundance (Goode et al. 2005). Sustained abundance of natural origin fish at current levels or higher will decrease long-term risks to the species.

Limiting factors identified for Snake River fall-run Chinook salmon include:
(1) Mainstem lower Snake and Columbia hydrosystem mortality, (2) degraded water quality and temperature, (3) reduced spawning and rearing habitat due to mainstem lower Snake River hydropower system, (4) harvest impacts, (5) impaired stream flows, barriers to fish passage in tributaries, excessive sediment, and altered floodplain and channel morphology (NMFS 2005b, SRSRB 2005).

Snake River Spring/Summer Chinook

This species occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. Environmental conditions are generally drier and warmer in these areas than in areas occupied by other Chinook species. Chinook-producing drainages occupied by the Snake River spring/summer-run Chinook salmon include the Grande Ronde, Imnaha, Salmon, and Tucannon river systems.

Snake River spring/summer-run Chinook salmon exhibit a stream-type life history. Juvenile fish mature in fresh water for one year before they migrate to the ocean in the spring of their second year. Adults re-enter the Columbia River in late February and early March after two or three years in the ocean. In high elevation areas, mature fish hold in cool, deep pools until late summer and early fall, when they return to their native streams to begin spawning. Eggs incubate through the fall and winter and emergence begins in the late winter and early spring. Juveniles migrate starting in early May through the middle of June.

The ICBTRT has identified 32 populations in 5 major population groups (Upper Salmon River, South Fork Salmon River, Middle Fork Salmon River, Grande Ronde/Imnaha, Lower Snake Mainstem Tributaries) for this species. Historic populations above Hells Canyon Dam are considered extinct (ICBTRT 2003).

Thus, despite the recent increases in total spring/summer-run Chinook salmon returns to the basin, natural origin abundance and productivity are still below their targets. The BRT has noted that SR spring/summer Chinook salmon remains likely to become endangered (Goode et al.2005). The VSP abundance goal is 2,000 spring/summer natural spawners.

Limiting factors identified for this species include: (1) Mainstem lower Snake and Columbia hydrosystem mortality, (2) reduced tributary stream flow, (3) altered tributary channel morphology, (4) excessive fine sediment in tributaries, (5) degraded tributary water quality and temperature (NMFS 2005b, SRSRB 2005).

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counted above Lower Granite Dam. These adult returns are about triple the 10-year average at these Snake River projects (FPC 2003).

Upper Columbia River Spring Chinook

Upper Columbia River (UCR) spring Chinook begin returning from the ocean in the early spring, with the run into the Columbia River peaking in mid-May. Spring Chinook enter the upper Columbia tributaries from April through July. After migration, they hold in freshwater tributaries until spawning occurs in the late summer, peaking in mid to late August. Juvenile spring Chinook spend a year in freshwater before emigrating to salt water in the spring of their second year. The UCR spring Chinook is composed of three MPGs: the Wenatchee River population, the Entiat River population, and the Methow River population.

The UCR spring-run Chinook salmon was reviewed by the West Coast BRT in late 1998 (NMFS 1998). The BRT was mostly concerned about risks falling under the abundance/distribution and trends/productivity risk categories. The BRT was concerned that at these decreasing population sizes, negative effects of demographic and genetic stochastic processes are likely to occur. Furthermore, both long- and short-term trends in abundance were declining, many strongly so. The BRT noted that the implementation of emergency natural broodstocking and captive broodstocking efforts indicated the severity of the population declines to critically small sizes. Habitat degradation, blockages and hydrosystem passage mortality all have contributed to the significant declines.

An initial set of population definitions for UCR spring-run Chinook salmon species along with basic criteria for evaluating the status of each population were developed using the VSP guidelines described in McElhany et al. (2000). Abundance, productivity and spatial structure criteria for each of the UCR Chinook salmon populations were developed and are described in Ford et al. (2001).

Many UCR Chinook salmon populations have rebounded somewhat from the critically low levels that immediately preceded the last status review evaluation. Although this was considered an encouraging sign by the BRT, the last year or two of higher returns come on the heels of a decade or more of steep declines to all time record low escapements. In addition, hatchery production from both production/mitigation and supplementation programs continues to have a large influence on UCR Chinook salmon. The extreme management measures taken in an effort to maintain UCR Chinook salmon populations during some years in the late 1990s (collecting all adults from major basins at downstream dams) are a strong indication of the ongoing risks to UCR Chinook salmon, although the associated hatchery programs may ultimately play a role in helping to restore self-sustaining natural populations.

Assessments by the latest BRT of the overall risks faced by UCR Chinook salmon were divided, with a slight majority (53 percent) of the votes being cast in the Adanger of extinction@ category and a minority (45 percent) in the Alikely to be endangered@ category. The risk estimates reflect strong ongoing concerns regarding abundance and growth rate/productivity (high to very high risk) and somewhat less (but still significant) concerns for spatial structure (moderate risk) and diversity (moderately high risk).

The VSP recovery criteria for UCR spring Chinook is at least 4500 naturally produced spawners, distributed among the three MPGs as follows: Wenatchee, 2000; Entiat, 500; and the Methow, 2000 (UCSRB 2007).

Limiting factors identified for this species include: (1) Mainstem Columbia River hydropower system mortality, (2) tributary riparian degradation and loss of in-river wood, (3) altered tributary floodplain and channel morphology, (4) reduced tributary stream flow and impaired passage, (5) degraded water quality and temperature, and (6) harvest impacts.

Lower Columbia River Chinook

The status of lower Columbia River (LCR) Chinook was initially reviewed by NMFS in 1998 (Myers et al. 1998) and updated by the biological review team (BRT) in that same year (NMFS 1998). In the 1998 update, the BRT noted several concerns for this listed species. The BRT was concerned that there were very few naturally self-sustaining populations of native Chinook salmon remaining in the LCR. A majority of the previous (1998) BRT concluded that the LCR Chinook salmon were likely to become endangered in the foreseeable future. A minority felt that LCR Chinook salmon were not presently in danger of extinction, nor were they likely to become so in the foreseeable future.

New data acquired for the Goode et al. (2005) report includes spawner abundance estimates through 2001, new estimates of the fraction of hatchery spawners and harvest estimates. In addition, estimates of historical abundance have been provided by the WDFW. Information on recent hatchery releases was also obtained. New analyses include the designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

A majority (71 percent) of the BRT votes for LCR Chinook salmon fell in the Alikely to become endangered@ category, with minorities falling in the Adanger of extinction@ and Anot likely to become endangered@ categories. Moderately high concerns for all Viable Salmonid Populations (VSP) elements are indicated by estimates of moderate to moderately high risk for abundance and diversity. All of the risk factors identified in previous reviews were still considered important by the BRT. The Willamette/Lower Columbia River Technical Review Team has estimated that 8-10 historic populations have been extirpated, most of them spring-run populations. Near loss of that important life history type remains an important BRT concern. Although some natural production currently occurs in 20 or so populations, only one exceeds 1,000 spawners. High hatchery production continues to pose genetic and ecological risks to natural populations and to mask their performance. Most LCR Chinook salmon populations have not seen increases in recent years as pronounced as those that have occurred in many other geographic areas. The VSP abundance goal is 45,000 Chinook spawners for the Washington Management Unit and the current abundance is just under 13,000.

Limiting factors identified for this species include: (1) Reduced access to spawning/rearing habitat in tributaries, (2) hatchery impacts, (3) loss of habitat diversity and channel stability in tributaries, (4) excessive fine sediment in spawning gravels, (5) elevated water temperature in tributaries, and (6) harvest impacts (NMFS 2005c).

Puget Sound Chinook

The Puget Sound Chinook ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington (March 24, 1999, 64 FR 14208). The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, 22 of which are believed to be extant currently (NMFS-TRT 2001). The populations presumed to be extinct are mostly early returning fish; most of these are in mid- to southern Puget Sound or Hood Canal and the Strait of Juan de Fuca. The ESU populations with the greatest estimated fractions of hatchery fish tend to be in mid- to southern Puget Sound, Hood Canal, and the Strait of Juan de Fuca.

Twenty-six artificial propagation programs are considered to be part of the ESU. Eight of the programs are directed at conservation, and are specifically implemented to preserve and increase the abundance of native populations in their natal watersheds where habitat needed to sustain the populations naturally at viable levels has been lost or degraded. Each of these conservation hatchery programs includes research, monitoring, and evaluation activities designed to determine success in recovering the propagated populations to viable levels, and to determine the demographic, ecological, and genetic effects of each program on target and non-target salmonid populations. The remaining programs considered to be part of the ESU are operated primarily for fisheries harvest augmentation purposes (some of which also function as research programs) using transplanted within-ESU-origin Chinook salmon as broodstock. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

Assessing extinction risk for the Puget Sound Chinook ESU is complicated by high levels of hatchery production and a limited availability of information on the fraction of natural spawners that are of hatchery-origin. Although populations in the ESU have not experienced the dramatic increases in abundance in the last 2 to 3 years that have been evident in many other ESUs, more populations have shown modest increases in escapement in recent years than have declined (13 populations versus nine). Most populations have a recent five-year mean abundance of fewer than 1,500 natural spawners, with the Upper Skagit population being a notable exception (the recent five-year mean abundance for the Upper Skagit population approaches 10,000 natural spawners). Currently observed abundances of natural spawners in the ESU are several orders of magnitude lower than estimated historical spawner capacity, and well below peak historical abundance (approximately 690,000 spawners in the early 1900s). Recent five-year and long-term productivity trends remain below replacement for the majority of the 22 extant populations of Puget Sound Chinook. The BRT was concerned that the concentration of the majority of natural production in just a few subbasins represents a significant risk. Natural production areas, due to their concentrated spatial distribution, are vulnerable to extirpation due to catastrophic events. The BRT was concerned by the disproportionate loss of early run populations and its impact on the diversity of the Puget Sound Chinook ESU. The Puget Sound Technical Recovery Team has identified 31 historical populations (Ruckelshaus et al. 2002), nine of which are believed to be extinct, most of which were "early run" or "spring" populations. Past hatchery practices that transplanted stocks among basins within the ESU and present programs using transplanted stocks that incorporate little local natural broodstock represent additional risk to ESU diversity. In particular, the BRT noted that the pervasive use of Green River stock, and stocks subsequently derived from the Green River stock, throughout the ESU may reduce the genetic diversity and fitness of naturally spawning populations.

The BRT found moderately high risks for all VSP categories. Informed by this risk assessment, the strong majority opinion of the BRT was that the naturally spawned component of the Puget Sound Chinook ESU is "likely to become endangered within the foreseeable future." The minority opinion was in the "not in danger of extinction or likely to become endangered within the foreseeable future" category (Goode et al. 2005).

In terms of productivity, these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004). However, long-term trends in abundance for naturally spawning populations of Chinook salmon in Puget Sound indicate that approximately half the populations are declining, and half are increasing in abundance over the length of available time series. The median over all populations of long-term trend in abundance is 1.0 (range 0.92–1.2), indicating that most populations are just replacing themselves. Over the long term, the most extreme declines in natural spawning abundance have occurred in the combined Dosewallips and Elwha populations. Those populations with the greatest long-term population growth rates are the North Fork Nooksack and White rivers. All populations reported above are likely to have a moderate to high fraction of naturally spawning hatchery fish, so it is not possible to say what the trends in naturally spawning, natural-origin Chinook salmon might be in those populations. White River spring Chinook (among others) were the subject of discussions with the Tribes during consultation because their life history is adapted to glacial runoff patterns. This life history distinguishes the White River spring Chinook from most of the other Puget Sound Chinook populations increasing their importance to recovery of Puget Sound Chinook for their contribution to life history diversity within the ESU. The VSP abundance goal is 60,580 to 271,640 natural spawners for the Puget Sound ESU and the most recent estimates of abundance is 32,850 (years 1996-2000).

Forestry practices, farming and urbanization have blocked or degraded fresh water habitat (Meyers et al. 1998). Limiting factors for Puget Sound Chinook salmon include: (1) Degraded floodplain and in-river channel structure, (2) degraded estuarine conditions and loss of estuarine habitat, (3) riparian area degradation and loss of in-river large woody debris, (4) excessive sediment in spawning gravels, (5) degraded water quality and temperature (NMFS 2005b).

Columbia River Chum

NMFS provided an updated status report on CR chum in 1999 (NMFS 1999). As documented in the 1999 report, the BRT was concerned about the dramatic declines in abundance and contraction in distribution from historical levels. The BRT was also concerned about the low productivity of the extant populations, as evidenced by flat trend lines at low population sizes. A majority of the BRT concluded that the CR chum salmon ESU was likely to become endangered in the foreseeable future and a minority concluded that the ESU was currently in danger of extinction.

New data includes spawner abundance through 2000, with a preliminary estimate in 2002, new information on the hatchery program, and new genetic data describing the current relationship of spawning groups. New analyses include designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate, and estimates of current and historically available kilometers of stream.

Updated information provided in the Goode et al. (2005), the information contained in previous Lower Columbia River status reviews, and preliminary analyses by the Willamette/Lower Columbia Technical Review Team suggest that 14 of the 16 historical populations (88 percent) are extinct or nearly so. The two extant populations have been at low abundance for the last 50 years in the range where stochastic processes could lead to extinction. Encouragingly, there has been a substantial increase in the abundance of these two populations. In addition there are the new (or newly discovered) Washougal River mainstem spawning groups. However, it is not known if the increase will continue and the abundance is still substantially below the historical levels.

The BRT likelihood votes for this ESU fell in the Alikely to become endangered@ (63 percent) or Adanger of extinction@ (34 percent) categories. The BRT had substantial concerns about every VSP element, as indicated by the risk estimates scores that ranged from moderately high for growth rate/productivity to high to very high for spatial structure. Most or all of the risk factors identified previously by the BRT remain important concerns. The Willamette/Lower Columbia Technical Review Team has estimated that close to 90 percent of the historical populations in the ESU are extinct or nearly so, resulting in loss of much diversity and connectivity between populations. The populations that remain are small, and overall abundance for the ESU is low. This ESU has showed low productivity for many decades, even though the remaining populations are at low abundance and density dependent compensation might be expected. The BRT was encouraged that unofficial reports for 2002 suggest a large increase in abundance in some (perhaps many) locations. Whether this large increase is due to any recent management actions or simply reflects unusually good conditions in the marine environment is not known at this time, but the result is encouraging, particularly if it were to be sustained for a number of years. The VSP abundance goal is 18,725 spawners for the ESU; the current abundance is over 20,200.

Limiting factors identified for Columbia River Chum Salmon include: (1) altered channel form and stability in tributaries, (2) excessive sediment in tributary spawning gravels, (3) altered stream flow in tributaries and mainstem Columbia, (4) loss of some tributary habitat types, and (5) harassment of spawners in tributary and Columbia mainstem (NMFS 2005b).

Hood Canal Summer Chum

This ESU includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington (March 25, 1999, 64 FR 14508). Eight artificial propagation programs are considered to be part of the ESU: the Quilcene National Fish Hatchery, Hamma Hamma Fish Hatchery, Lilliwaup Creek Fish Hatchery, Union River/Tahuya, Big Beef Creek Fish Hatchery, Salmon Creek Fish Hatchery, Chimacum Creek Fish Hatchery, and the Jimmycomelately Creek Fish Hatchery summer-run chum hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the species (NMFS, 2005a).

The HC summer-run chum salmon are defined in SASSI (WDF et al. 1993) as fish that spawn from mid-September to mid-October. However summer chum have been known to enter natal rivers in late August. Fall-run chum salmon are defined as fish that spawn from November through December or January. Run-timing data from as early as 1913 indicated temporal separation between summer and fall chum salmon in Hood Canal (Johnson et al. 1997). HC summer chum salmon are genetically distinct from healthy populations of HC fall chum salmon originating within this area. HC summer chum return to natal rivers to spawn during the August through early October period, whereas fall chum salmon spawn between November and December, when streams are higher and water temperature is lower.

The HC summer chum ESU has two distinct MPGs (Strait of Juan de Fuca and Hood Canal) that each include multiple sub-populations as outlined below (WDFW and PNPTT 2000; PSTRT 2004):

Sub-population	Major Population
Snow/Salmon	
Chimacum (1, 2)	Strait of Juan de Fuca
Jimmycomelately	
Dungeness	
Quilcene	
Dosewallips	
Duckabush	
Hamma Hamma	
Lilliwaup	Hood Canal
Finch (1)	
Skokomish	
Union	
Tahuya (1, 2)	
Dewatto (1)	
Anderson (1)	
Big Beef (1, 2)	

[1)] Recently extinct populations.
[2)] Population reintroduction in progress through on-going or recently completed hatchery transfer/stock reintroduction programs.

Three primary factors combined to cause the decline in abundance and distribution of HC summer chum in the 1980's and 1990's: Habitat loss; fishery over-exploitation; and climate related changes in stream flow patterns (WDFW and PNPTT 2000). Individual sub-populations likely have been differentially impacted by these factors for decline. Declines of HC summer chum salmon sub-populations originating in the Hood Canal portion of the ESU appeared to be the result of the combined effects of lower survivals caused by habitat degradation, climate, increases in fishery exploitation rates, and the impacts associated with the releases of hatchery salmonids. For Strait of Juan de Fuca region sub-populations, the combined effects of reductions in habitat quality, stream flows, and fishery exploitation resulted in low summer chum salmon production (WDFW and PNPTT 2000). Numbers of spawning summer-run chum in Discovery Bay and Sequim Bay were also at low levels with declining trends. The widespread degradation and loss of lower floodplain, estuary, and nearshore marine habitat was noted by the BRT as a continuing threat throughout the two regions harming ESU spatial structure and sub-population connectivity.

The BRT found high risks for each of the VSP categories. Informed by this risk assessment, the majority opinion of the BRT was that the naturally spawned component of the Hood Canal summer-run chum is "likely to become endangered within the foreseeable future," with a minority opinion that the ESU is "in danger of extinction" (Goode et al. 2005).

Population preservation and recovery measures developed by WDFW and the Point No Point Treaty Tribes (co-managers) under the *Summer Chum Salmon Conservation*

Initiative were implemented beginning in 1992 to protect and restore summer chum salmon sub-populations. Actions under the co-managers' regulatory purview included hatchery-based supplementation and reintroduction using indigenous stocks, and protective measures in tribal and recreational fisheries directed at other salmon species. The VSP abundance goal for recovery is 14,240 spawners for the ESU; the current abundance is over 32,000.

Limiting factors identified for this species include: (1) Degraded floodplain and mainstem river channel structure, (2) Degraded estuarine conditions and loss of estuarine habitat, (3) Riparian area degradation and loss of in-river wood in mainstem, (4) Excessive sediment in spawning gravels, (5) reduced stream flow in migration areas (NMFS 2005b, HCCC 2005).

Lower Columbia River Coho

The status of lower Columbia River (LCR) coho salmon was initially reviewed by NMFS in 1996 and the most recent review occurred in 2001. In the 2001 review, the BRT was very concerned that the vast majority (over 90 percent) of the historical populations of LCR coho salmon appear to be either extirpated or nearly so. The two populations with any significant production (Sandy and Clackamas) were at appreciable risk because of low abundance, declining trends, and failure to respond after a dramatic reduction in harvest. The large number of hatchery coho salmon in the ESU was also considered an important risk factor. The majority of the 2001 BRT votes were for Aat risk of extinction@ with a substantial minority in Alikely to become endangered.@

Since the status of the LCR coho salmon was reviewed by the BRT in 2000, relatively little new information was available for the 2003 review. A majority (68 percent) of the 2003 likelihood votes for LCR coho salmon fell in the Adanger of extinction@ category, with the remainder falling in the Alikely to become endangered@ category. As indicated by the risk matrix totals, the BRT had major concerns for this ESU in all VSP risk categories (risk estimates ranged from high risk for spatial structure/connectivity and growth rate/productivity to very high for diversity). The most serious overall concern was the scarcity of naturally-produced spawners, with attendant risks associated with small population, loss of diversity, and fragmentation and isolation of the remaining naturally-produced fish. In the only two populations with significant natural production (Sandy and Clackamas), short and long-term trends are negative and productivity (as gauged by pre-harvest recruits) is down sharply from recent (1980s) levels. The VSP abundance goal is 7,725[6] spawners for the Washington Management Unit, well under a recent WDFW estimate of abundance of over 36,000.

The following habitat limiting factors for recovery of the Washington Management Unit of the Lower Columbia/Willamette coho salmon ESU: degraded floodplain and channel morphology, altered instream flows in tributaries, impaired fish passage in tributaries,

[6] The coho salmon abundance goal is a temporary placeholder that was not adopted by either the LCFRB or NMFS because good estimates of abundance were incomplete. The WDFW recently came out with an estimate that places abundance at over 36,000.

excessive sediment and temperatures in tributaries, and degraded riparian habitat (NMFS 2005a).

Snake River Sockeye

Anadromous sockeye salmon returning to Redfish Lake in Idaho's Stanley Basin travel a greater distance from the sea (approximately 900 miles) to a higher elevation (6,500 feet) than any other sockeye salmon population and are the southern-most population of sockeye salmon in the world (Bjornn et al. 1968; Foerster 1968). Stanley Basin sockeye salmon are separated by 700 or more river miles from two other extant upper Columbia River populations in the Wenatchee River and Okanogan River drainages. These latter populations return to lakes at substantially lower elevations (Wenatchee at 1,870 feet, Okanagon at 912 feet) and occupy different ecoregions.

The only extant sockeye salmon population in the Snake River basin at the time of listing was that in Redfish Lake, in the Stanley Basin (upper Salmon River drainage) of Idaho. Other lakes in the Snake River basin historically supported sockeye salmon populations, including Wallowa Lake (Grande Ronde River drainage, Oregon), Payette Lake (Payette River drainage, Idaho) and Warm Lake (South Fork Salmon River drainage, Idaho) (Waples et al. 1997). These populations are now considered extinct. Although kokanee, a resident form of *Oncorhynchus nerka*, occur in numerous lakes in the Snake River basin, other lakes in the Stanley Basin and sympatrically with sockeye in Redfish Lake, resident *O. nerka* were not considered part of the species at the time of listing (1991). Subsequent to the 1991 listing, a residual form of sockeye residing in Redfish Lake was identified. The residuals are non-anadromous, completing their entire life cycle in freshwater, but spawn at the same time and in the same location as anadromous sockeye salmon. In 1993, NMFS determined that residual sockeye salmon in Redfish Lake were part of the Snake River sockeye salmon. Also, artificially propagated sockeye salmon from the Redfish Lake Captive Propagation program are considered part of this species (70 FR 37160; June 28, 2005). NMFS has determined that this artificially propagated stock is genetically no more than moderately divergent from the natural population (NMFS 2005c).

Recent annual abundances of natural origin sockeye salmon in the Stanley Basin have been extremely low. No natural origin anadromous adults have returned since 1998 and the abundance of residual sockeye salmon in Redfish Lake is unknown. This species is entirely supported by adults produced through the captive propagation program at the present time. Current smolt-to-adult survival of sockeye originating from the Stanley Basin lakes is rarely greater than 0.3 percent (Hebdon et al. 2004). The current average productivity likely is substantially less than the productivity required for any population to be at low (1-5 percent) extinction risk at the minimum abundance threshold. The BRT determined that the SR sockeye salmon remains in danger of extinction (Goode et al. 2005).

Limiting factors identified for SR sockeye include: (1) Reduced tributary stream flow, (2) impaired tributary passage and blocks to migration, and (3) mainstem Columbia River hydropower system mortality (NMFS 2005a).

Lake Ozette Sockeye

Run sizes of Ozette Lake sockeye numbered in the thousands during the early 1900's. Commercial harvest of these sockeye declined during the latter half of the 20th century. A small ceremonial fishery continued until 1981, and no direct fishery on this stock since 1982 (Gustafson et al. 1997). Over fishing and habitat degradation have reduced the Ozette Lake sockeye population to its current level of less than 1,000 fish per 5-year average. Ozette Lake sockeye salmon have experienced downward trend in abundance for several years. The VSP abundance goals have not yet been determined for Lake Ozette sockeye salmon.

The preliminary draft Lake Ozette Sockeye Recovery Plan identifies the following habitat limiting factors for recovery of the ESU: sediment delivery from tributaries (turbidity and suspended sediment concentration), altered shorelines, predation, water quality (high stream temperatures, low frequency – high intensity turbidity events in tributaries), stream flow, reduced pool depth, reduced quality and quantity of beach spawning in the lake, lake level fluctuations, channel simplification and increased sediment production and delivery to streams, and decreased channel stability and floodplain alterations.

Snake River Steelhead

The Snake River basin (SRB) steelhead species includes all naturally spawned populations of steelhead (and their progeny) in streams in the SRB of southeast Washington, northeast Oregon, and Idaho (62 FR 43937; August 18, 1997). The SRB steelhead do not include resident forms of *O. mykiss* (rainbow trout) co-occurring with these steelhead.

The Interior Columbia Basin Technical Recovery Team (ICBTRT) identified 23 populations in the following six major population groups (MPGs) in this species: Clearwater River, Grande Ronde River, Hells Canyon, Imnaha River, Lower Snake River, and Salmon River (ICBTRT 2003). The BRT noted that SRB steelhead remain spatially well distributed in each of the six major geographic areas in the Snake River basin (Goode et al. 2005). Environmental conditions are generally drier and warmer in these areas than in areas occupied by other steelhead species in the Pacific Northwest. SRB steelhead were blocked from portions of the upper Snake River beginning in the late 1800s and culminating with the construction of Hells Canyon Dam in the 1960s.

Sexually immature adult SRB steelhead return to the Columbia River between late June and October. They are considered a summer run and are known as a stream-maturing type. SRB steelhead returns consist of A-run fish that spend one year in the ocean, and larger B-run fish that spend two years at sea. Adults typically migrate upriver until they reach tributaries from 1,000 to 2,000 meters above sea level where they spawn between March and May of the following year. Unlike other anadromous members of the *Oncorhynchus* genus, some adult steelhead survive spawning, return to the sea, and later return to spawn a second time. After hatching, juvenile SRB steelhead typically spend 2 to 3 years in fresh water before they smolt and migrate to the ocean. The SRB steelhead "B run" population levels remain particularly depressed.

The paucity of information on adult spawning escapement for specific tributary production areas for SRB steelhead made a quantitative assessment of viability difficult. Despite the recent increases in SRB steelhead returns, the BRT believes that the species remains at moderate risk for abundance, productivity, and diversity. Consequently, the BRT has determined that SRB steelhead remains likely to become endangered (Goode et al. 2005). The VSP abundance goal is 2,000 spawners; current abundance is slightly over 1,200.

Limiting factors identified for SRB steelhead include: (1) Lower Snake and Columbia rivers hydrosystem mortality, (2) reduced tributary streamflow, (3) altered tributary channel morphology, (4) excessive fine sediment in tributaries, (5) degraded tributary water quality, (6) harvest and hatchery related adverse effects (NMFS 2005b).

Upper Columbia River Steelhead

The 1998 steelhead status review identified a number of concerns for UCR steelhead. While the total abundance of populations within this species has been relatively stable or increasing, it appears to be occurring only because of major hatchery supplementation programs. The major concern for this species is the failure of natural stocks to replace themselves. The previous BRT members were strongly concerned about the problems of genetic homogenization due to hatchery supplementation, apparent high harvest rates on steelhead smolts in rainbow trout fisheries and the degradation of freshwater habitats within the region, especially the effects of grazing, irrigation diversions and hydroelectric dams.

A slight majority (54 percent) of the BRT votes for this species fell in the Adanger of extinction@ category, with most of the rest falling in the Alikely to become endangered@ category. The most serious risk identified was growth rate/productivity, estimated to be high to very high; other VSP factors were also relatively high, ranging from moderate for spatial structure to moderately high for diversity. The last 2 to 3 years have seen an encouraging increase in the number of naturally-produced fish. However, the recent mean abundance in the major basins is still only a fraction of interim recovery targets. Furthermore, overall adult returns are still dominated by hatchery fish, and detailed information is lacking regarding productivity of natural populations. The VSP abundance goal is 3,000 steelhead spawners for the ESU; the current abundance is 1,050.

Liming factors identified for the UCR steelhead include: (1) Mainstem Columbia River hydropower system mortality; (2) reduced tributary streamflow; (3) tributary riparian degradation and loss of in-river wood; (4) altered tributary floodplain and channel morphology; and (5) excessive fine sediment and degraded tributary water quality (NMFS 2005b).

Middle Columbia River Steelhead

Middle Columbia River (MCR) steelhead include all naturally-spawned populations of steelhead in streams within the Columbia River basin from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River in Washington, excluding steelhead from the Snake River basin (64 FR 14517, March 25, 1999). The major tributaries occupied by this species are the Deschutes, John Day, Klickitat, Umatilla, Walla Walla, and Yakima river systems. The John Day River represents the largest naturally spawning, native stock of steelhead in the region. The MCR steelhead do not include resident forms of *O.mykiss* (rainbow trout) co-occurring with these steelhead.

The ICBTRT (2003) identified 15 populations in four major population groups (Cascades Eastern Slopes Tributaries, John Day River, the Walla Walla and Umatilla rivers, and the Yakima River) and one unaffiliated independent population (Rock Creek) in this species. There are two extinct populations in the Cascades Eastern Slope major population group (MPG), the White Salmon River and Deschutes River above Pelton Dam.

The MCR steelhead remain well-distributed in the majority of occupied subbasins. However, natural returns to the Yakima River, once a major historical production center for the species, continue to be less than 20 percent of the interim recovery abundance target for the subbasin (Goode et al. 2005). The presence of substantial numbers of out-of-basin (and largely out-of-species) natural spawners in the Deschutes River raised substantial concern within the NMFS BRT regarding the genetic integrity and productivity of the native Deschutes population.

The five-year average return (geometric mean) of natural MCR steelhead for 1997-2001 was up from previous years' basin estimates (Goode et al. 2005). Returns to the Yakima River, the Deschutes River and sections of the John Day River system were substantially higher compared to 1992-1997 (Goode et al. 2005). Yakima River returns are still substantially below interim target levels and estimated historical return levels, with the majority of spawning occurring in one tributary, Satus Creek (Berg 2001). Recent 5-year geometric mean annual returns to the John Day basin are generally below the corresponding mean returns reported in previous status reviews. However, each major production area in the John Day system has shown upward trends since the 1999 return year (Goode et al. 2005).

Thus, despite recent increases in MCR steelhead returns, the BRT believes that the species remains at moderate risk for all four VSP parameters. Consequently the BRT has determined that MCR steelhead remain likely to become endangered (Goode et al. 2005). The VSP abundance goal is 5,750 spawners, and the current abundance is estimated to be fewer than 1,500.

Limiting factors identified for MCR steelhead include: (1) Hydropower system mortality at mainstem Columbia River dams, (2) reduced stream flow in tributaries, (3) impaired passage in tributaries, (4) excessive fine sediment in stream substrates, (5) degraded water quality, and (6) altered channel morphology (NMFS 2005b).

Lower Columbia River Steelhead

The status of LCR steelhead was initially reviewed by NMFS in 1996 (Busby et al. 1995), and the most recent review occurred in 1998 (NMFS 1998a). In the 1998 review, the BRT noted several concerns for this ESU, including the low abundance relative to historical levels, the universal and often drastic declines observed since the mid-1980s, and the widespread occurrence of hatchery fish in naturally-spawning steelhead populations. Analysis also suggested that introduced summer steelhead may negatively affect winter native winter steelhead in some populations. A majority of the 1998 BRT concluded that LCR steelhead were at risk of becoming endangered in the foreseeable future.

A large majority (over 79 percent) of the BRT votes for this species fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT found moderate risks in all the VSP categories, with mean risk matrix scores ranging from moderately low for spatial structure to moderately high for both abundance and growth rate/productivity. All of the major risk factors identified by previous BRTs still remain. Most populations are at relatively low abundance, and those with adequate data for modeling are estimated to have a relatively high extinction probability. The VSP abundance goal is 11,625 spawners for the Washington Management Unit, and the current abundance is 3,600.

Limiting factors identified for LCR steelhead include: (1) Degraded floodplain and stream channel structure and function, (2) reduced access to spawning/rearing habitat, (3) altered streamflow in tributaries, (4) excessive sediment and elevated water temperatures in tributaries, and (5) hatchery impacts (NMFS 2005b).

Puget Sound Steelhead

General information on Puget Sound steelhead is available in the Puget Sound steelhead BRT report (PSSBRT 2005) and a draft assessment by WDFW (2006). Steelhead use most rivers and many coastal streams in Puget Sound for spawning and rearing. The PSSBRT concluded that the risk to the viability of Puget Sound steelhead due to declining productivity is high. Nearly all steelhead populations in the DPS exhibited diminished productivity as indicated by below-replacement population growth rates, and declining short and long-term trends in natural escapement and total run size. For example, once considered one of the strongholds of the DPS, as recent as 1996 (Busby et al. 1995), the Skagit River populations were showing downward trends in escapement, total run size, recruitment, and population growth. Yet the Skagit River populations are considered relatively healthy compared to other populations within the DPS. The

PSSBRT concluded that the major risk factors facing Puget Sound steelhead are widespread declines in abundance and productivity for most natural steelhead populations in the DPS, including those in Skagit and Snohomish rivers, the low abundance of several summer run populations; and the sharply diminishing abundance of some steelhead populations, especially in south Puget Sound, Hood Canal, and the Strait of Juan de Fuca. VSP abundance goals have not yet been determined for the Puget Sound steelhead DPS.

The limiting factors for recovery of the Puget Sound Chinook salmon ESU are also limiting to the Puget Sound steelhead. These include: degraded floodplain and in-river channel structure, degraded nearshore/marine and estuarine conditions and loss of associated habitat, riparian area degradation and loss of in-river large woody debris, excessive sediment in spawning gravels, degraded water quality and temperature, impaired instream flows, and barriers to fish passage.

Table 4. References for additional background on listing status, critical habitat, protective regulations, and biological information for all species addressed in this consultation

Species	ESU or DPS	Listing Status	Critical Habitat	Protective Regulations	Biological Information, Population Trends
Chinook	Snake River Fall	June 28, 2005 70 FR 37160 Threatened	December 28, 1993 58 FR 68543	June 28, 2005 71 FR 37160	Goode et al. 2005
	Snake River Spring/Summer	June 28, 2005 70 FR 37160 Threatened	October 25, 1999 64 FR 57399	April 22, 1992 57 FR 14653	Goode et al. 2005
	Upper Columbia River Spring	June 28, 2005 70 FR 37160 Endangered	September 2, 2005 70 FR 52630	June 28, 2005 71 FR 37160	Goode et al. 2005
	Lower Columbia River	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	July 10, 2000 65 FR 42422	Goode et al. 2005
	Puget Sound	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	July 10, 2000 65 FR 42422	Goode et al. 2005
Chum	Columbia River	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	June 28, 2005 71 FR 37160	Goode et al. 2005
	Hood Canal Summer	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	July 10, 2000 65 FR 42422	Goode et al. 2005
Coho	Lower Columbia River	June 28, 2005 70 FR 37160 Threatened	Under development	June 28, 2005 71 FR 37160	Goode et al. 2005
Sockeye	Snake River	June 28, 2005 70 FR 37160 Endangered	December 28, 1993 58 FR 68543	June 28, 2005 71 FR 37160	Goode et al. 2005
	Ozette Lake	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	June 28, 2005 71 FR 37160	Goode et al. 2005
Steelhead	Snake River	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	July 10, 2000 65 FR 42422	Goode et al. 2005
	Upper Columbia River	August 18, 1997 62 FR 43937 Endangered	September 2, 2005 70 FR 52630	February 1, 2006 71 FR 5178	Goode et al. 2005
	Middle Columbia River	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	July 10, 2000 65 FR 42422	Goode et al. 2005
	Lower Columbia River	June 28, 2005 70 FR 37160 Threatened	September 2, 2005 70 FR 52630	July 10, 2000 65 FR 42422	Goode et al. 2005
	Puget Sound	May 11, 2007 72 FR 26722 Threatened	Under development	Under development	Goode et al. 2005

Status of Critical Habitat

Critical habitat is defined as the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features that are essential to the conservation of the species, and which may require special management considerations or protection. Critical habitat can also include specific areas outside the geographical area occupied by the species at the time it is listed that are determined by the Secretary to be essential for the conservation of the species (Endangered Species Act of 1973, as amended, section 3(5)(A)).

The action area for this consultation contains designated critical habitat. The species addressed by this consultation have had critical habitat designated between 1993 and 2005 (refer to Table 4). Two species within the action area, PS steelhead and LCR coho, do not yet have critical habitat designated.

NMFS reviews the status of designated critical habitat affected by the proposed action by examining the condition of primary constituent elements, and/or essential features of habitat[7] throughout the designated areas (PCEs). Many of the ESUs and DPSs addressed in this consultation share the same rivers and estuaries, have similar life history characteristics and, therefore, require many of the same PCEs. These PCEs include sites with physical features essential to the conservation of the ESU (for example, spawning gravels, water quality and quantity, side channels, forage species) because these features enable spawning, rearing, migration, and foraging behaviors essential for survival and recovery. Specific types of sites and the features associated with them include: (1) freshwater spawning sites with water quality and quantity conditions and substrates supporting spawning, incubation and larval development; (2) freshwater rearing sites with, (i) water quality and quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, (ii) water quality and forage supporting juvenile development, and (iii) natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks; (3) freshwater migration corridors free of obstruction and excessive predation with water quality and quantity conditions and natural cover (as described in 2(iii) above) supporting juvenile and adult mobility and survival; (4) estuarine areas free of obstruction and excessive predation with, (i) water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater, (ii) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and (iii) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation; (5) nearshore marine areas free of obstruction

[7] Critical habitat for three species of salmonids was designated in 1993. These include Snake River Sockeye, Snake River fall Chinook, and Snake River spring/summer Chinook. To be designated critical, habitat must contain features essential to support at least one lifestage of the listed specie. Essential habitat types for these species can be generally described to include the following: (1) juvenile rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; (4) adult migration corridors; and (5) spawning areas.

and excessive predation with, (i) water quality and water quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation, and (ii) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (6) offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. PCEs relevant to this consultation include: freshwater spawning; freshwater rearing; and, freshwater migration.

The designated critical habitat areas currently contain PCEs required to support the biological processes for which the species use the habitat. NMFS defined the lateral extent of designated critical habitat as the width of the stream channel defined by the ordinary high-water line as defined by the U.S. Army Corps of Engineers (COE) in 33 CFR 329.11. In areas for which ordinary high-water has not been defined pursuant to 33 CFR 329.11, the width of the stream channel shall be defined by its bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain (Rosgen, 1996) and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series (Leopold, 1994). Such an interval is commensurate with nearly all of the juvenile freshwater life phases of salmon and steelhead ESUs/DPSs. Moreover, the bankfull elevation can be readily discerned for a variety of stream reaches and stream types using recognizable water lines (e.g., marks on rocks) or vegetation boundaries (Rosgen, 1996).

In designating critical habitat in estuarine and nearshore areas, NMFS determined that extreme high water is the best descriptor of lateral extent of critical habitat for those areas. For nearshore marine areas NMFS focused particular attention on the geographical area occupied by the Puget Sound ESUs (Chinook and Hood Canal summer-run chum salmon) because of the unique ecological setting and well-documented importance of the area's nearshore habitats to these species. NMFS designated the area inundated by extreme high tide because it encompasses habitat areas typically inundated and regularly occupied during the spring and summer when juvenile salmon are obligatory migrants in the nearshore zone, relying heavily on forage, cover, and refuge qualities provided by these habitats.

Snake River Fall Chinook Critical Habitat

The critical habitat for the Snake River fall Chinook salmon was listed on December 28, 1993 (58 FR 68543) and modified on March 9, 1998 (63 FR 11515) to include the Deschutes River. With hydro development, the most productive areas of the Snake River Basin historically are now inaccessible or inundated. The upper reaches of the mainstem Snake River were the primary areas used by fall-run Chinook salmon, with only limited spawning activity reported downstream. The construction of Brownlee Dam (1958), Oxbow Dam (1961), and Hells Canyon Dam (1967) eliminated the primary production areas of Snake River fall-run Chinook salmon. There are now 12 dams on the mainstem Snake River, and they have substantially reduced the distribution and abundance of fall-run Chinook salmon (Irving and Bjornn 1981). Cumulatively, past activities have reduced the amount of suitable substrate, impaired water quality (including temperature) and water quantity, and other important attributes which have affected Chinook spawning, juvenile rearing, and migration (adult and juvenile) within this ESU.

Snake River Spring/Summer Chinook Critical Habitat

The critical habitat for the Snake River spring/summer Chinook salmon was listed on December 28, 1993 (58 FR 68543). Designated critical habitat consists of the water, waterway bottom, and adjacent riparian zone of specified lakes and river reaches in hydrologic units presently or historically accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). In general, the habitats used for spawning and early juvenile rearing are different among the three Chinook salmon forms (spring, summer, and fall) (Chapman et al. 1991, as cited in Meyers 1998). In both the Columbia and Snake Rivers, spring Chinook salmon tend to use small, higher elevation streams (headwaters), and fall Chinook salmon tend to use large, lower elevation streams or mainstem areas. Summer Chinook are more variable in their spawning habitats; in the Snake River, they inhabit small, high elevation tributaries typical of spring Chinook salmon habitat, whereas in the upper Columbia River they spawn in the larger lower elevation streams characteristic of fall Chinook salmon habitat. Differences are also evident in juvenile out-migration behavior. In both rivers, spring Chinook salmon migrate swiftly to sea as yearling smolts, and fall Chinook salmon move seaward slowly as subyearlings. Summer Chinook salmon in the Snake River resemble spring-run fish in migrating as yearlings, but migrate as subyearlings in the upper Columbia River. Early researchers categorized the two behavioral types as "ocean-type" Chinook for seaward migrating subyearlings and as "stream-type" Chinook for the yearling migrants (Gilbert 1912). Cumulatively, past activities have reduced the amount of suitable substrate and have impaired water quality (including temperature), water quantity, and other important attributes which have affected Chinook spawning, juvenile rearing, and migration (adult and juvenile) within this ESU.

Upper Columbia River Spring Chinook Critical Habitat

The critical habitat for Upper Columbia River Chinook salmon was redesignated in 2005 (final rule 09/09/05; 70 FR52630). Excluded were the areas above Chief Joseph Dam and areas above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years

Spawning and rearing and migratory habitat in the Columbia River and its tributaries upstream of the Yakima River includes dry areas where conditions are less conducive to Chinook survival than in many other parts of the Columbia River Basin (Goode 2005). 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. Cumulatively, past activities have impaired water quality (including temperature) water quantity, water velocity and other important attributes which have affected Chinook spawning, juvenile rearing, and migration (adult and juvenile) within this ESU.

Lower Columbia River Chinook Critical Habitat

Critical habitat designation for this ESU was finalized in September 2005 (70 FR 52630). As in other ESUs, Chinook salmon have been affected by the alteration of freshwater habitat (Bottom et al. 2001, 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 supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. These ports primarily focus on the transport of timber and agricultural commodities. The most extensive urban development in the lower Columbia River occurs in the Vancouver/Camas area. Outside of this major urban area, the majority of residential development relies on septic systems. Common water contaminants associated with urban development and residential septic systems include excessive water temperatures, lowered DO, increased fecal coliform bacteria, and increased chemicals associated with rural, urban and industrial runoff.

Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon access to a wide expanse of low-velocity marshland and channel habitats (Bottom et al. 2001). In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming salmonid habitat during flooding river discharges or flood tides. The lower Columbia River lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats by 1970. It has been estimated there has been an 80 percent reduction in emergent vegetation production and a 15 percent decline in benthic diatom and algae production (Sherwood et al. 1990).

Altered channel morphology and stability, lost/degraded floodplain connectivity are substantial limiting factors in the lower Columbia River and its tributaries. Other factors affecting critical habitat PCEs are loss of habitat diversity, excessive sediment, degraded water quality and increased temperatures. Reduced stream flows and fish passage blockages have limited access to spawning and rearing areas (NMFS 2005b).

Puget Sound Chinook Critical Habitat

Critical habitat has been designated in Puget Sound for PS Chinook salmon. Major tributary river basins in the Puget Sound Basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar River, Sammamish River, Green/Duwamish River, Soos Creek, Puyallup River, White River, Carbon River, Nisqually River, Skokomish, Duckabush, Dosewalips, Big Quilcene, Dungeness and Elwha rivers.

The PS Chinook salmon life history stages that require properly functioning freshwater habitat components have been affected by natural and man-made influences. In the steep mountainous and foothill areas of the Puget Sound Basin, relatively unconsolidated glacial deposits and heavy rainfall make this region vulnerable to landslides (WDNR 1993, WDNR 1997a, WDNR 1997b, Kruckeberg 1998). Lands prone to shallow rapid landslides are often managed for timber, because they are unsuited to most other uses. Landslides can occur naturally, but inappropriate land use practices can accelerate their frequency.

Fine sediment enters river channels from slides and runoff from unpaved roads. Unpaved roads are widespread on forestlands, and to a lesser extent, in rural residential areas and recreational forestlands.

Historic timber harvest removed most of the riparian trees from the stream and river channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys. Riparian zones through these areas are now dominated by alder, cottonwood, invasive canary grass and blackberries, and provide substantially reduced shade and large woody debris (LWD) recruitment.

Diking, agriculture, revetments, railroads and roads in lower stream and river reaches have caused substantial loss of secondary channels in major valley floodplains throughout the region. Confined main channels create high-energy peak flow events that remove smaller substrates and LWD. The loss of side-channels, oxbow lakes, and backwater habitats results in appreciable loss of juvenile salmonid and steelhead rearing and refuge habitat (WSCC 2000). When the water level in Lake Washington was permanently dropped in the early 1900's, thousands of acres of wetlands along the lake's shoreline, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses (WSCC 2001).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of turbidity, from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture impacts, have been documented in many Puget Sound tributaries.

Peak stream flows have increased over time due to increasing amounts of impervious surface cover and forest land conversions, reduced percolation, simplified drainage networks, loss of wetlands, and rain-on-snow events in higher elevations.

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook and steelhead populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat (e.g., the Elwha Dam on the Elwha River at river mile 6 has blocked access to over 70 miles of once productive habitat), changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and LWD to reaches downstream. These actions promote downstream channel incision and simplification, limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport (Hunter 1992). Migrating fish diverted into unscreened or inadequately screened water conveyances, or turbines result in high mortality rates.

In summary, critical habitat throughout the Puget Sound basin has been degraded by numerous management activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of LWD, expansive urbanization, agriculture, alteration of stream morphology, disconnection from floodplains, wetland draining and conversion, dredging, timber harvest and mining. Changes in habitat quantity, availability, diversity, flow, and temperature, sediment load, and channel stability are common factors affecting freshwater PCE's of spawning, rearing, and migration for PS Chinook and steelhead.

Columbia River Chum Critical Habitat

The critical habitat for Columbia River chum salmon was designated in September 2005 (70 FR 52630). The designation includes all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) in the Columbia River downstream of Bonneville Dam. Habitat issues addressed above for LCR Chinook also apply to Columbia River chum affecting the same PCEs (freshwater spawning, freshwater rearing, and freshwater migration).

Hood Canal Summer Chum Critical Habitat

HC summer chum critical habitat was designated 09/02/05 (70 FR 52630). The Hood Canal summer run chum ESU includes presently unoccupied habitat within its critical habitat designation. The HC summer chum salmon have similar habitat issues to PS Chinook and PS steelhead. One exception however, is water temperatures are generally properly functioning for the three freshwater PCEs.

Snake River Sockeye Critical Habitat

The critical habitat for the Snake River sockeye salmon was designated on December 28, 1993 (58FR68543). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon and is designated as critical habitat for the species. Habitat for spawning and juvenile rearing has been reduced by availability of spawning gravel, water quality and quantity, water temperature, food, riparian vegetation, and access. Juvenile and adult migration has been restricted by these same factors, in addition to water velocity, cover/shelter, and safe passage.

Lake Ozette Sockeye Critical Habitat

The critical habitat for this sockeye ESU was finalized 09/02/05 (70 FR52630). Critical habitat includes several tributaries, the lake outlet, and the lake's 36.5 miles of shoreline (Ritchie 2005). Current and local spawning locations, as well as vegetation and substrate conditions along the lake shoreline, are not likely representative of past spawning distribution and shoreline conditions. Spawning and rearing in the lake have been reduced by factors that are not well understood, but may include alterations of the lake's hydro-period, colonization of native and non-native vegetation, and reduced numbers of sockeye spawning on the beach. Additional potential factors include increased sediment delivery from nearby tributaries, high temperatures, and shoreline development.

Snake River Steelhead Critical Habitat

The critical habitat for Snake River steelhead was designated on September 2, 2005 (70 FR 52630). The designated habitat includes all river reaches accessible to listed steelhead in the Snake River and its tributaries in Idaho, Oregon, and Washington.

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 and juvenile rearing areas have been degraded by overgrazing, as well as by historic gold dredging and sedimentation due to past land management. Habitat in the Snake basin is warmer and drier and often more eroded than elsewhere in the Columbia River basin or in coastal areas. Loss of riparian cover, shelter, access, water quality, water quantity, and reduced water velocity appreciably affects juvenile and adult migration.

Upper Columbia River Steelhead Critical Habitat

The critical habitat for Upper Columbia River steelhead was designated on September 2, 2005 (70 FR 52630). The designation includes all river reaches accessible to listed steelhead in Columbia River tributaries upstream of the Yakima River, Washington, and downstream of Chief Joseph Dam.

Construction of the Chief Joseph and Grand Coulee dams caused blockages of substantial habitat, as did that of smaller dams on tributary rivers (NMFS 2000). Habitat issues affecting spawning and rearing, juvenile and adult migration for this ESU arise mostly from irrigation diversions and hydroelectric dams, altered hydrology, as well as degraded riparian and instream habitat from urbanization and livestock grazing.

Middle Columbia River Steelhead Critical Habitat

The critical habitat for Mid Columbia River steelhead was designated on September 2, 2005 (70 FR 52630). Critical habitat consists of all river reaches accessible to listed steelhead in Columbia River tributaries except the Snake River between Mosier Creek in

Oregon and the Yakima River in Washington (inclusive). Habitat degradation affecting spawning and rearing, juvenile and adult migration includes an altered hydrology due to water diversions and hydro, impacts from live stock grazing and riparian vegetation removal.

Lower Columbia River Steelhead Critical Habitat

The critical habitat for Lower Columbia River steelhead was designated on September 2, 2005 (70 FR 52630). The designated critical habitat consists of all river reaches accessible to listed steelhead in Columbia River tributaries between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers ion Oregon, inclusive. Habitat issues addressed above for LCR Chinook also apply to LCR steelhead affecting the same PCEs (freshwater spawning, freshwater rearing, and freshwater migration).

Environmental Baseline

The purpose of this section is to identify 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 process (50 CFR 402.02). The EPA's proposed approval of the WQS may potentially affect all freshwater bodies within the state of Washington that are or could be used by listed salmon.

The following provides context of how EPA's approval of standards relates to their implementation of on-the-ground actions that indirectly affect listed species. Washington=s surface water quality standards consist of three primary components:

1. Designated uses that are assigned to the waters;
2. Numeric narrative criteria that are designed to protect the specified designated uses; and
3. A water quality antidegradation program that provides special protection for existing uses and high quality waters.

The water quality standards establish the foundation for the state=s water pollution control programs. Under state and Federal laws, human sources of pollution must not cause or contribute to degrading water quality that exceeds the water quality standards. As such, regulated activities must be conditioned and designed to achieve the water quality standards. While the water quality standards of the state of Washington apply broadly to all categories and sources of pollution, there are jurisdictional and practical limitations that affect how well certain sources of pollution are brought into compliance. The following provides a general overview of the CWA programs that affect water quality in the state of Washington.

Water Quality Assessments and Total Maximum Daily Loads

Consistent with sections 303(d) and 305(b) of the CWA, every two years Ecology conducts an assessment of the health of its waters. Part of that assessment includes identifying any waters that do not meet the state water quality standards. Any waters where data show the standards are not being met are placed on an impaired waters list. Waters on this list are then prioritized for water quality management plans that identify the actions that are needed to bring the waters into compliance with the water quality standards. The water quality management plans are a primary mechanism for determining how much pollutant reduction will be required from each contributing source. The pollutant allocations placed in these plans are then used in the National Pollutant Discharge Elimination System (NPDES) permits for point sources of pollutants, and serve to guide watershed restoration programs for nonpoint sources.

The temperature and dissolved oxygen water quality standards that EPA proposes to approve will set the benchmarks that will (a) be the basis for listing waters on the 303(d) list of impaired waters in the future, and (b) serve as the temperature and dissolved oxygen targets in future TMDLs. Implementation of TMDLs will generally be beneficial to listed salmonid species, because the TMDLs will be designed to reduce current water temperatures and increase DO to levels that are more protective of listed species.

A review of the temperature TMDL's that have been completed to date, shows that these plans rely heavily on existing programs to meet the load reduction targets to attain water quality standards. For example, to improve water temperature on forest lands, the Federal Forest Plan is the implementation mechanism for Federal lands and the State's Forest Practices Act is the implementation mechanism for state lands. For agricultural lands, the primary mechanism is grant/loan incentive programs through the State's Conservation Districts. For urban lands, local ordinances in accordance with the Shorelines Management Act, Growth Management Act, and Ecology's Municipal Stormwater general permit are the primary mechanisms. The NPDES program is the mechanism used to address point sources discharges. The ESA section 10 Habitat Conservation Plans and Federal actions under Section 7 (e.g., operations of Federal dams or fish hatcheries) may also be implementation mechanisms to attain water quality standards. Additionally, TMDLs help prioritize areas for restoration to aid in acquiring special project funding, such as CWA 319 grants and salmon recovery funds.

Point Source Discharges of Pollutants

Point sources refer to pollutants that enter surface waters from a discrete location such as a discharge pipe. There are two categories of permits: (1) municipal and industrial, and (2) general permits. Municipal wastewater treatment facilities and industrial facilities that discharge wastewater are regulated under NPDES permits. These permits set limits to the amount of pollutants that may be discharged into surface waters. Limitations are established for wastewater wherever: a) the EPA or the state has established minimum technology-based controls for a wastewater pollutant for the type of activity being regulated, or b) a reasonable potential exists for the wastewater discharge to exceed a water quality criterion. The NPDES permits are reissued on a five year cycle that allows new water quality standards to be considered and incorporated in existing permits. Temperature and dissolved oxygen-related effluent limits are common limits included in NPDES permits for municipal and industrial discharges.

In areas where the WQS are becoming more stringent, it is anticipated that the baseline condition will improve because the discharge limits will become more stringent in order to meet the new water quality standard. However, for new NPDES sources, the environmental baseline may be degraded because the permit will allow a new source of pollutants to be discharged into the water body.

The General Permit program was established in recognition there are some point sources of pollutants that are minor contributors individually but are numerous around the state. General permits cover a wide range of potential dischargers (e.g., stormwater, municipal drinking water, dairies, animal feeding operations, boatyards, aquatic pesticides, fish hatcheries, log sort yards, and sand and gravel operations). General permits generally do not include specific water quality-based effluent limits. Rather, they use a menu of best management practices, or in some cases discharge benchmarks, to meet standards. The stormwater water general permits control run-off rates and effect summer base flows, which can affect the temperature levels in the river. The stormwater permits also control peak flow conditions, which can affect the physical conditions of the river, which in turn can affect water temperature.

Dams and Hydrological Modifications

Modifications to the channels, substrate, or flows of surface waterbodies are not regulated through a single permit program such as exists for point source pollutants. As such, opportunities to bring the wide variety of activities in this category into compliance with the water quality standards are highly variable.

Most existing and new proposed private and public utility hydropower dams require a federal operating license from the Federal Energy Regulatory Commission. As part of obtaining the license, the state must certify (under section 401 of the Clean Water Act) that the operation of the dam will not cause or contribute to a violation of the state water quality standards. As part of the 401 certification, a state may establish conditions for operation and structural improvements to protect water quality. These state requirements become part of the facilities Federal license. Dams with reservoirs can have a substantial effect on river temperatures and certifying that the dam meets temperature standards is a challenging aspect of many 401 certifications. Owners of non-hydropower dams are required by state and Federal law to meet state water quality standards. However, the state has no comprehensive regulatory mechanism to ensure compliance at these dams.

Although Federal agencies are required by law to meet state water quality standards, meeting the temperature standards is a challenge for many dams (e.g., Federal dams on the Columbia, Snake, and Yakima Rivers). Because the state has no direct permitting or regulatory authority over federal projects, state agencies must rely on negotiations and, if necessary, lawsuits against Federal agencies, to bring these projects into compliance with the standards.

Federal Irrigation Projects are similar to federal dams. The state does not possess formal review or permitting authority over these projects. The state does, however, have the authority to establish discharge permits to condition the application of aquatic pesticides in these waters. This is because the application of pesticides can be considered point source pollution.

Construction activities that occur in streams require a hydraulic permit from the WDFW. The primary purpose of these permits is to protect fish habitat and to notify Ecology if it appears that water quality standards may be violated through an approved permit (typically focused on spikes in turbidity, which is an important water quality issue). Temperature and DO are typically not a significant issue with these permits.

Nonpoint Source Controls

People or entities that contribute to nonpoint source pollution are not allowed to cause or contribute to a violation of the water quality standards. Ecology recognizes that nonpoint sources can be a primary contributing factor to elevated stream temperatures in certain watersheds. Unfortunately, no formal permit or review program exists to regulate nonpoint sources of pollution. Additionally, some potential solutions to nonpoint source pollution, such as establishing buffers and setbacks in building ordinances and zoning restrictions, are not within the authority and influence of Ecology. With the notable exception of forest practices activities, Ecology relies on cost sharing and voluntary incentive programs to obtain compliance from nonpoint sources. Due to limited resources, Ecology reserves formal enforcement actions for only the most serious situations.

Forestry. The Washington forest practice regulations are specifically designed to ensure compliance with the state surface water quality standards. In June 2006, the Services approved the state's Habitat Conservation Plan and signed ESA section 10(a)(1)(B) permits for incidental "take" under the existing State Forest Practice Rules. This means that freshwater habitats for ESA-listed and unlisted salmonids were analyzed for potential short and long term effects from implementing existing Forest Practice Rules and found to provide for long term survival and recovery of those salmonids throughout the State. In addition, through an adaptive management process, best management practices (prescriptions) undergo scientific scrutiny to select and promulgate rules that will meet the state standards. These rules are applied to forest practices on private and some state forest lands throughout the state. Revisions to the WQS are to be followed by further evaluations to determine to what extent, if any, current prescriptions may need to be changed in order to comply with the new standards.

Agriculture. No formal program exists to regulate nonpoint pollution from farms. Agricultural return water from nonpoint source runoff is exempt from NPDES permitting, except for agricultural operations which specifically require NPDES permits (e.g. dairies, feed lots, fish farms, etc.). For those agricultural operations that are not regulated under NPDES permits, Ecology primarily relies on education, cost sharing, and voluntary programs to bring them into compliance with the standards. For facilities that create serious problems or threats to water quality, Ecology pursues formal enforcement actions to bring them rapidly into compliance. Ecology has entered into a memorandum of agreement with the state's conservation districts. The districts take a lead role in developing farm plans that will curb nonpoint runoff from problem farms and attain compliance with the state standards. These farm plans are also voluntarily adopted by farmers wanting to improve their operations. Agricultural activity has considerable impact of temperature and DO levels. Therefore, the new standards will serve to guide these agricultural related programs.

Urban Development. There is no formal review or permitting programs for nonpoint source pollution caused by urbanization. However, Ecology does anticipate the requirements of the municipal stormwater NPDES permits will assist source control efforts. Ecology recently expanded its municipal stormwater permit program to include small and medium cities located within the U.S. Census defined urban areas. The municipal stormwater permit program has not yet expanded to small municipalities outside the Census defined urban areas. Construction stormwater, industrial stormwater, and municipal stormwater NPDES permits are, however, designed to address point sources of pollution in the urban environment. As discussed above, urban stormwater can impact temperature conditions in the river. As more monitoring occurs, if rivers fail to attain standards (including the new temperature standards), stormwater permits may be revised to require more stringent measures to attain standards.

NMFS can describe the environmental baseline in terms of the habitat features and processes necessary to support all life stages of each listed species within the action area. Reviewing how present environmental conditions bear on the existing habitat quality, quantity, and function provides a context for discerning and examining the effects of the proposed action, and how those effects relate to the extant risks affected salmon and steelhead already face with respect to their conservation. Each listed species considered in this Opinion resides in or migrates through the action area. Thus, this consultation focused on the salmon and steelhead habitat characteristics that support successful completion of freshwater and estuarine life history phases, e.g., transition to freshwater, adult return migration and holding, spawning, egg incubation, hatch, fry development, rearing, freshwater migration, transition to marine water.

Based on the life histories of the 15 ESUs and DPSs analyzed in this consultation, NMFS determined that it is likely that incubating eggs, fry development, juvenile, smolt, and adult life stages of these listed species would be present in the action area where changes in the WQS would be present in the environment. NMFS found that some elements of the proposed changes to the Ecology WQS are likely to adversely affect the ESA-listed species and designated critical habitat.

The EPA determined in its BE that the proposed WQS revisions, although they will generally improve habitat conditions for listed salmon and steelhead, may still result in adverse affects on listed species. Inadequate temperatures or dissolved oxygen levels could affect survival at most life-history stages (with the exception of sub-adult and adult marine survival). EPA's proposed approval of Washington's WQS has the potential to affect all waters within the state boundaries that are used by ESA-listed salmon and steelhead, i.e., the action area.

The ESA-listed ESUs and DPSs have been listed in part because their habitats have been substantially degraded from human activities. Human changes to the landscape have generally increased river warming, which adversely affects salmonids and reduces the number of river segments thermally suitable to the developmental needs of salmon. Human activities can increase water temperatures by increasing the heat load into the river, by reducing a river's capacity to absorb heat, and by eliminating or reducing the amount of groundwater flow which moderates temperatures and provides cold water refugia. Examples in which human development has caused excess warming of rivers are summarized below.

1) Removal of streamside vegetation reduces the amount of shade that blocks solar radiation and allows solar heating of streams. Examples of human activities that have reduced shade include past forest harvesting, agricultural land clearing, livestock grazing, and on-going urban development (Murphy et al. 1981, NRC 2002, Spence et al. 1996, May et al. 1997, Karr and Chu 1999, Bauer and Ralph 2001).

2) Removal of streamside vegetation also reduces bank stability, thereby causing bank erosion and increased sediment loading into the stream. Bank erosion and increased sedimentation results in wider and shallower streams, which increases the stream's heat load by increasing the surface area subject to solar radiation and heat exchange with the air (Booth 1990, Horner et al. 1997, Spence et al. 1996, Miller et al. 1988, Miller et al. in press, May et al. 1997, Bauer and Ralph 2001).

3) Water withdrawals from rivers for purposes such as agricultural irrigation and municipal and industrial use result in less river volume. The temperatures of rivers with smaller volumes equilibrate faster to surrounding air temperature, which leads to higher maximum water temperatures in the summer, compared to conditions without water withdrawals (Spence et al. 1996, Karr and Chu 1999, Bauer and Ralph 2001).

4) Water discharges from industrial facilities, wastewater treatment facilities and irrigation return flows can add heat to rivers as described in National Discharge Pollutant Elimination System (NPDES) permits issued by Ecology (see http://www.ecy.wa.gov/programs/wq/permits/index.html#wastewater_individual_permits).

5) Channeling, straightening, or diking rivers for flood control and urban and agricultural land development; or other activities that eliminates channel sinuosity, can substantially reduce cool groundwater flow into a river that

moderates summertime river temperatures. These human actions can affect hyporheic flow, the water that is exchanged between the river and the riverbed. (Coutant 1999, Poole and Berman 2000).

6) Removal of upland vegetation and the creation of impervious surfaces associated with urban development increases storm runoff and can reduce the amount of groundwater that is stored in the watershed and slowly filters back to the stream in the summer to cool water temperatures (May et al. 1997, Karr and Chu 1999, Hartley et al. 2001, Hartley and Funke 2001, Paul and Meyer 2001).

7) Dams and their reservoirs can affect thermal patterns in a number of ways (Coutant 1999). They can increase maximum temperatures by holding waters in reservoirs to warm, especially in shallow areas near shore. Reservoirs, due to their relatively large volume of water, are more resistant to temperature change which results in reduced diurnal temperature variation and prolonged periods of warm water. For example, dams can delay the natural cooling that takes place in the late summer-early fall, thereby harming late summer-fall migration runs. Reservoirs also inundate alluvial river segments, thereby diminishing the groundwater exchange between the river and the riverbed (i.e., hyporheic flow) that cools the river and provides cold water refugia during the summer (Poole and Berman 2000). Further, dams can appreciably reduce the river flow rate, thereby causing juvenile migrants to be exposed to high temperatures for a much longer time than they would under a natural flow regime. Temperatures below a dam can be either substantially warmer or cooler than without the dam, depending on the origins of the water releases: when cold water is released from the bottom of a thermally stratified reservoir behind a dam, downstream water temperature can be cooled depending on season and relative amounts of released flows.

Current Water Quality in Washington

Washington has collected 7-DADMax temperature data for a number of major rivers since 2001. The data are summarized in Table 5 below. The table gives a general overview of water bodies that exceed the temperature criterion and those that are at or below the temperature criterion. The EPA rated the water bodies in one of the following categories:

High Temperature. A water body is included in this category if one of the following three scenarios apply: (1) the aquatic life use is "Core summer salmonid habitat," and the water body has had at least one 7-DADMax temperature greater than 20° C; (2) the aquatic life use is "Salmonid spawning, rearing, and migration," and the water body has had at least one 7-DADMax temperature above 21.5° C; or (3) the aquatic life use is "Salmonid rearing, and migration only," and the water body has had at least one 7-DADMax temperature above 21.5° C.

Moderately High Temperature. A water body is included in this category if one of the following three scenarios apply: (1) the aquatic life use is "Core summer salmonid habitat," and the water body has had at least one 7-DADMax temperature in the range of 17° C - 19.9° C; (2) the aquatic life use is "Salmonid spawning, rearing, and migration," and the water body has had at least one 7-DADMax temperature in the range of 18.5° C - 21.4° C; or (3) the aquatic life use is "Salmonid rearing, and migration only," and the water body has had at least one 7-DADMax temperature in the range of 18.5° C - 21.4° C.

At or Below Temperature Criterion. A water body is included in this category if one of the following three scenarios apply: (1) the aquatic life use is "Core summer salmonid habitat," and the 7-DADMax temperature is at or below 16° C; (2) the aquatic life use is "Salmonid spawning, rearing, and migration," and the 7-DADMax temperature is at or below 17.5° C; or (3) the aquatic life use is "Salmonid rearing, and migration only," and the 7-DADMax temperature is at or below 17.5° C.

Table 5. 7-DADMax temperature data collected by the Washington State Department of Ecology.

Category	WRIA	River	Aquatic Life Use	7 DADMax temperature range (° C)	Number of years with 7-DADMax
High	5	S.F. Stillaguamish	Core summer salmonid habitat	19.9 – 22.1	N=5; 2001-2005
	5	Mid - Stillaguamish	Core summer salmonid habitat	20.9 – 23.4	N=5; 2001-2005
	5	N.F. Stillaguamish	Core summer salmonid habitat	19.9 – 22.3	N=5; 2001-2005
	7	Lower Skykomish	Core summer salmonid habitat	18.3 – 21.3	N=3; 2001-2003
	7	Mid - Snoqualmie	Core summer salmonid habitat	18.4 – 20.5	N=5; 2001-2005
	8	Near mouth of Cedar	Core summer salmonid habitat	18.3 – 20.7	N=5; 2001-2005
	13	Lower Deschutes	Salmonid spawning, rearing, migration	19.1-20.5	N=5; 2001-2005
	22	Mid - Humptulips	Core summer salmonid habitat	20.6 – 21.9	N=4; 2002-2005
	23	Chehalis near Porter Creek	Salmonid spawning,rearing,migration	22.3 – 24.1	N=5; 2001-2005
	23	Chehalis at Dryad	Core summer salmonid habitat	21.7 – 24.3	N=5;2001-2005
	24	Mid Willipa	Salmonid spawning,rearing,migration	22 – 22.7	N=2; 2000 -2002
	24	Upper Naselle	Core summer salmonid habitat	18.7 – 21.7	N=4; 2001-2004
	27	Mid E.F. Lewis	Core summer salmonid habitat	23.2 – 25.9	N=5; 2001-2005
	27	Kalama River, near mouth	Core summer salmonid habitat	18.5 – 20.3	N=5; 2001-2005
	32	Walla Walla, near mouth	Salmonid rearing and migration	27.8 - 30	N=5; 2001– 2005
	34	S.F. Palouse, near Idaho border	Salmonid spawning,rearing,migration	20.4 – 23.8	N=5; 2001-2005
	34	Palouse, near Idaho border	Salmonid spawning,rearing,migration	26.6 – 29.1	N=5, 2001-2005
	35	Tucannon, near Snake	Salmonid spawning,rearing,migration	25.3 – 26.5	N=5; 2001-2005
	37	Yakima, near Ahtanum Creek	Salmonid spawning,rearing,migration	15.1 – 22.9	N=3; 2001– 2003
	38	Cowiche Creek, near Naches river	Salmonid spawning,rearing,migration	22.4	N=1; 2005
	39	Yakima River, near Cle Elum	Core summer salmonid habitat	20.2 – 21.9	N=5; 2000 – 2005
	41	Crab Creek, near	Salmonid rearing,migration	28 – 28.8	N=5; 2001-2005

Category	WRIA	River	Aquatic Life Use	7 DADMax temperature range (° C)	Number of years with 7-DADMax
		Columbia River			
	45	Wenatchee River, near Leavenworth	Core summer salmonid habitat	18.8 – 23.5	N=5; 2001, 2002, 2005
	45	Wenatchee River, near Columbia River	Salmonid spawning, rearing, migration	22.4	N=1; 2001
	46	Entiat River, near Columbia River	Salmonid spawning, rearing, migration	20.9 – 24.3	N=5; 2001 – 2005
	48	Methow River near Columbia River	Salmonid spawning, rearing, migration	23.4 – 24.6	N=5; 2001, 2003-2005
Moderate	1	Lower Nooksack	Core summer salmonid habitat	17.4-19.2	N=5; 2001-2005
	3	Skagit near Mount Vernon	Core summer salmonid habitat	17.6-18.3	N=2, 2004-2005
	9	Green River, mid river	Core summer salmonid habitat	17.9 – 20	N=4, 2001, 2003-2005
	10	Lower Puyallup, on tribal reservation land	On tribal land, no state designation	17.5-18.4	N=2; 2002-2003
	11	Nisqually, near mouth of river	Core summer salmonid habitat	16.1 - 17.5	N=5; 2001-2005
	15	Mission Creek	Core summer salmonid habitat	17.2	N=1; 2003
	18	Dungeness, near mouth	Core summer salmonid habitat	17.2 – 18.6	N=4, 2002-2005
	18	Lower Elwha	Core summer salmonid habitat	16.3 – 18.9	N=5; 2001– 2005
	20	Hoh River, DNR campground	Core summer salmonid habitat	16 – 17.8	N=4; 2001-2003, 2005
	26	Cowlitz River, near Columbia River	Salmonid spawning, rearing, migration	17.8 – 19.1	N=4; 2001-2003, 2005
At or Below Criterion	4	Skagit, near Marblemount	Core summer salmonid habitat	13 – 14.9	N=5; 2001– 2005
	15	Union River, near mouth	Core summer salmonid habitat	15.1	N=1; 2003
	15	Little Mission Creek	Core summer salmonid habitat	12.8	N=1; 2003
	15	Stimson Creek	Core summer salmonid habitat	15	N=1; 2003
	15	Olalla Creek	Core summer salmonid habitat	14.9	N=1; 2003
	16	Skokomish River	Core summer salmonid habitat	14.7 – 15.2	N=5; 2001- 2005
	16	Duckabush	Core summer salmonid habitat	13.2 – 15	N=5; 2001- 2005

Many of the rivers that drain the Cascade Mountains west of the crest start out cool but then gradually warm up as they drop in elevation and enter the open agricultural and rural landscapes of the lower basin. The rivers on the Olympic Peninsula generally have temperatures which are at or below the water quality criterion. Exceptions include the lower Elwha and Dungeness. Elevated water temperatures in the latter two rivers are attributed to warming in the reservoirs and water withdrawals for irrigation in a highly disturbed channel, respectively.

Most of the rivers in Eastern Washington have summer maximum temperatures that are well above the standards. Although many of the rivers east of the Cascade Crest meet the standards in the upper basin (on National Forests or protected areas), water temperatures warm as rivers descend and where substantial landscape changes have occurred (e.g. timber harvest, reservoirs, grazing, agriculture) and/or the rivers enter the arid ecological region of the Columbia Plateau.

Impaired Waters [(303(d) List] in Washington

The CWA establishes as a national goal "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable." When a lake, river, stream or other water body fails to meet water quality standards, the CWA requires the state to place the water body on a list of "impaired" water bodies called the 303(d) list. States are required to prepare a 303(d) list every two years.

Ecology compiles and assesses available water quality data on a statewide basis in order to assess status of water quality in Washington's waters. The assessed waters are placed in categories which describe the status of the water quality. For each of the water bodies placed on the 303(d) list, a "water cleanup plan," also known as a total maximum daily load (TMDL), must be developed. The TMDL identifies the likely cause(s) of the water quality exceedences and outlines steps that need to be taken to reduce or eliminate the exceedence. An implementation schedule is then developed that sets a timeline for bringing the water body into compliance with the standards.

The potential categories into which water bodies may fall include:

- *Category 1*: Meets tested standards. Placement in this category does not necessarily mean that a water body is free from all pollutants. Most water quality monitoring is designed to detect a specific array of pollutants, so placement in this category means that the water body met standards for the pollutants for which it was tested.

- *Category 2*: Waters of concern. Where there is some evidence of a water quality problem, but not enough to require production of a TMDL calculation and implementation report. There are several reasons why a water body might be placed in this category: 1) the water body might have pollution levels that are not high enough to violate the water quality standards, 2) there may not be enough violations to categorize it as impaired, or 3) there may be data showing water quality violations, but the data were not collected using proper scientific methods and are unreliable.

- *Category 3*: No data. This category that will be largely empty. Water bodies that have not been tested will not be individually listed, but if they do not appear in one of the other categories, they are assumed to belong here.

- *Category 4*: Polluted waters that do not require a TMDL. These waters have pollution problems that are being solved in one of three ways.

- *Category 4*a – Water bodies that have an approved TMDL in place and are actively being implemented.
- *Category 4*b – Water bodies that have pollution control plans in place that are expected to solve the water quality problem. While pollution control plans are not TMDLs, they have many of the same features and there is a legal or financial guarantee that they will be implemented.
- *Category 4*c – Water bodies that are impaired by factors that cannot be addressed through a TMDL. These impairments include low flow, stream channelization, and dams. These problems require complex solutions to help restore streams to functioning conditions.

- *Category 5*: Polluted waters that require a TMDL. This is the traditional list of "impaired" water bodies. A water body that is in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants.

The latest comprehensive assessment by Ecology in 2002 included 32,165 stream segments. The system used for this assessment defines segments of rivers, streams, and lakes of less than 1,500 acres as that portion of the water body lying within a given section of a township (about a one mile square). Of the total number of stream segments that were assessed, about two thirds appear to be compliant for the pollutant that was monitored. The rest are either showing evidence of problems or will require attention to prevent further degradation. Approximately 13 percent of these are waters of concern (Category 2), 9 percent are impaired by physical factors (Category 4c), and 8 percent are on the 303(d) list (Category 5).

The number of stream segments on the Category 5 list has increased from the 1998 list by about 725 water body segments. While over half of the 1998 303(d) listings moved off the list, new listings were added as the result of new monitoring data gathered since 1998 (Ecology 2004). In the 1998 assessment, 642 streams and lakes were represented on the 303(d) list, many of them with numerous segments monitored for more than one pollutant parameter. In the 2002/2004 assessment, 800 rivers and lakes were in Category 5 of the 303(d) list. This is an increase of 166 new waters on the 303(d) list (Ecology 2004).

The key parameters affecting water quality in Washington are fecal coliform, temperature, dissolved oxygen, pH, and total phosphorus. Of the total list of polluted waters, about 70 percent are for these parameters. A substantial increase in 303(d) listings is related to temperature. The breakout of the key pollutant parameters, based on a total of 2,682 listings in Category 5, is as follows:

- Temperature: 33 percent (876) of the total listings;
- Fecal coliform: 25 percent (672) of the total listings;
- Dissolved oxygen: 10 percent (280) of the total listings;
- Total phosphorus: 2 percent (50) of the total listings; and

- Other pollutants (toxics, metals, other): 30 percent (804) of total listings (Ecology 2004).

Environmental conditions relevant to the salmon and steelhead ESUs and DPSs affected by the proposed action are described in the 2006 State of the Salmon in Washington (GSRO 2007). For each of the six geographic salmon regions in the State, water temperature, and other water quality parameters are listed among the factors limiting salmon survival and recovery. This is demonstrated below in Table 6. This table is a subset of impaired water bodies extracted from Table 4-4 (starting on page 73) in the BE provided by the EPA. Table 4-4 lists all of the streams in the state that are impaired for temperature. The table below also lists DO impaired streams and focuses on those water bodies that coincide with designated critical habitat for listed salmon and steelhead, or are streams that flow into designated critical habitat.

Table 6: Salmon and steelhead critical habitat impaired for temperature, dissolved oxygen, and/or other habitat features (instream flow)

Stream Name	Temp	Dissolved Oxygen	Flows
Nooksack River, mainstem	Cat 5		
Lower SFk Nooksack, Lower MFk Nooksack,Lower Canyon,	Cat 5		
Upper SFk Nooksack	Cat 2		Cat 4c
Skagit River	Cat 2		
Noname and Indian Slough		Cat 5	
Joe Leary Slough		Cat 2	
Stillaguamish River	Cat 5		
SFk Stillaguamish R	Cat 2	Cat 4a	
NFk Stillaguamish R	Cat 4a		
Canyon Cr and Upper Deer Cr	Cat 5		
Jorgenson /Church Cr		Cat 5	
Portage Cr, Hat Slough		Cat 4a	
Snohomish River, mainstem	Cat 2	Cat 4a	
Cedar R	Cat 2		
Snoqualmie R, mainstem and S Fk Skykomish R, and Pilchuck R	Cat 5		
Bear, Beaver, Catherine, Olney, Pekola, and Ferguson Cr	Cat 5		
Several sloughs	Cat 2	4a	
Cedar River	Cat 5		
Sammamish R	Cat 5	Cat 5	Cat 4c
Tributaries	Cat 5	Cat 2	
Lake Washington			Cat 4c
Duwamish Waterway/Green River	Cat 2		
Green R	Cat 2		Cat 4c
Puyallup River, mainstem	Cat 2		Cat 4c
White R	Cat 2		Cat 4c
Clearwater R	Cat 5		

Stream Name	Temp	Dissolved Oxygen	Flows
Greenwater R, South Prairie Cr	Cat 4a		Cat 4c
Straight, Wilkeson, Brush, Greenwater, Pyramid, Straight Cr	Cat 4a		
Fife Ditch, Meeker Ditch		Cat 5,2	
Nisqually River			Cat 4c
McAllister Cr		Cat 5	
Skokomish River	Cat 4a		Cat 4c
N Fk Skokomish R	Cat 4a		
SFk Skokomish R	Cat 2		
Elwha River	Cat 5		
Morse, Lyre, Bell Cr	Cat 2		
Dungeness River			Cat 4c
Hoh River	Cat 2		
Kalaloch, Matheney, and Sams R	Cat 5		
Queets River	Cat 2		
Quinault River	Cat 2		
Salmon R, M Fk Salmon, Coal, Matheney, Ziegler, and Kahkwa Cr	Cat 2		
Joe Creek		Cat 2	
Chehalis River/Grays Harbor	Cat 2		
Wishkah and Johns River	Cat 2		
Columbia River, Lower	Cat 5	Cat 2	Cat 4c
Lewis River	Cat 5		
EFk Lewis, Clear Cr, Muddy R, Clearwater Cr, Copper, Quartz, Kalama, and Siouxon Cr	Cat 5		
Columbia River, Middle	Cat 5	Cat 2	Cat 4c
Little Klickitat R	Cat 4a		
Walla Walla River	Cat 2	Cat 2	Cat 4c
Touchet R, Fk and SFk Touchet, and Wolf Fork	Cat 5	Cat 2	
Little Walla Walla and all forks	Cat 5	Cat 2	
Mill Cr	Cat 5	Cat 2	Cat 4c
Blue, Caldwell, Coates, Cold, Coppei, Doan, Dry, Cottonwood, Jim, Lewis, Pine, Garrison, Robinson, Whiskey, Russel, and Yellowjacket Creeks	Cat 5	Many also Cat 2 for DO	
Snake River	Cat 5	Cat 2	Cat 4c
Middle Snake River			Cat 4c
Charley, N and SFk Asotin, Cummins, Tucannon, Meadow, Panjab, and Turkey Cr	Cat 5		
Little Tucannon R	Cat 2		
Columbia River	Cat 5	Cat 2	Cat 4c
Yakima River	Cat 5	Cat 5	Cat 4c
Ahtanum Cr	Cat 2		

Stream Name	Temp	Dissolved Oxygen	Flows
Naches River	Cat 2		Cat 4c
American R, Bumping R, Crow, Rattlesnake, Tieton R and SFk Tieton, and the Little Naches River	Cat 5	Cat 5	
Bear, Blowout, Cowiche (all forks), Gold, Little Rattlesnake, Mathew, Nile, and Reynolds Cr	Cat 5		
Upper Yakima River	Cat 2	Cat 5	Cat 4c
Cle Elum R	Cat 5		
Blue, Caribou, Cascade, Cherry, French Cabin, Naneum, North Branch, Parke, Thorpe, Umtanum,	Cat 5		
Teanaway R and all forks	Cat 4a		Cat 4c
Taneum			Cat 4c
Wenatchee River	Cat 5	Cat 5	
Icicle Cr, Chiwaukum, Chiwawa, Little Wenatchee, Nason, Wenatchee, Peshastin	Cat 5		Cat 4c
Brender and Icicle Cr		Cat 5	
Second, Brender, Sand, Chumstick, Tronsen, Mission, Fish Lake Run	Cat 5	Cat 2 - Chumstick	Many Cat 4c
Entiat River	Cat 2		
Methow River	Cat 5		Cat 4c
Chewuch R	Cat 5		Cat 4c
Early Winters			Cat 4c
Lost R, Wolf, Twisp R	Cat 2		Cat 4c
Pend Oreille River	Cat 5		Cat 4c
Calispell, Cedar (Ione), Lime, Little Muddy, Ruby, Sullivan, Ruby, Lost	Cat 5		
Le Clerc	Cat 5		

Most of the temperature and dissolved oxygen impairments listed in Table 6 are in rearing or migratory corridors, or the lower reaches of spawning and rearing areas of ESA-listed salmon and steelhead. Some water quality problems occur in the middle to upper watersheds, such as areas where the riparian vegetation has been removed by logging, grazing, agriculture, or development.

The CWA establishes a process for states in developing information on the quality of its surface waters. Section 305(b) of the CWA requires that each state periodically prepare a water quality assessment report. To conduct a comprehensive statewide assessment, the EPA recommends using a "sample survey" approach. A sample survey approach allows for the estimation of the conditions of waters statewide by making inferences from a defined set of monitoring locations. Sample surveys are intended to produce assessments of the condition of the entire resource when that resource cannot be subject to a complete census.

The data collected as part of Washington=s 2002 305(b) report for indicators with numeric criteria in the water quality standards were used to assess the impairment of specific designated uses (Ecology 2002). The EPA guidance recommends using the specific frequency that data exceed numeric criteria to determine impairment of beneficial uses such as aquatic life and recreational uses.

Ecology selected stream stations stratified according to size and ecoregion to represent subpopulations of the target resource (e.g., aquatic life use designation). Ecoregions denote areas of general similarity in the type, quality, and quantity of environmental resources. The following ecoregions were used:

- Coast Range (SW Washington)
- Puget Lowlands
- SW Washington (Clark County area)
- West Cascades and Olympic Mountains
- East Cascades and Foothills
- Columbia Basin
- Northern Rockies (Pend Oreille Area)
- Blue Mountains (Asotin County Area)

If one or more of the related individual uses assessed at a station were identified as fair or poor, the overall aquatic life use at a station were considered impaired. If all uses at a station were identified as good, then the overall aquatic life use at a station was rated as good.

In the 2002 statewide water quality assessment for the Section 305(b) report, Ecology covered over 70,000 miles of streams, representing 98 percent of the total streams in Washington. The remaining 2 percent of streams were from areas where samples were not collected. Results of the 305(b) report are outlined in tables 4-5 through 4-27 of the BE. According to these on-going assessments, 47 percent of the streams in the state supported the overall uses and approximately 86 percent of the streams support the aquatic life uses. However, in their review of the 2002 standards, the EPA, fisheries resource managers (tribes and WDFW), and Services determined that the standards did not adequately protect existing aquatic life uses in many streams because Ecology did not use current fish distribution data. Since the need to use current fish distribution data is the primary reason why the standards are being revised, the assessment results for aquatic life uses and fish spawning and migration are believed to not be accurate.

The assessment indicates that 30 percent of the stream impairments statewide are related to temperature and 15 percent attributed to low DO. The Columbia Basin Ecoregion, Clark County area, and large rivers in the Puget lowlands have the highest number of streams with temperature-related impairments, while the percent of impaired streams is much lower for smaller streams and the Cascades, Olympics, and Blue Mountain Ecoregions.

Over 50 percent of the streams in the Puget lowlands, east Cascades, Columbia Basin and Northern Rockies Ecoregions are impaired by metals, with nearly 60 percent of all streams statewide affected by this pollution parameter. Fecal coliform is another indicator of pollution that is observed in most of the rivers in Washington. According to the assessment results, between 35 and 50 percent of the streams in all of the geographic areas (except the Blue Mountains) have use impairments caused by fecal coliform.

Water pollution of almost every category is increasing, as are hazardous waste emissions, air pollution, toxic releases, and waste generation. Sedimentation and increased water temperature related to logging, mining, urban development, and agriculture are limiting factors identified in salmon recovery plans throughout the state.

Habitat Conditions and Non-Native Species

At least forty species of freshwater fish have been introduced in Washington and are now self-sustaining, making up nearly half of the state's freshwater fish fauna (Wydoski and Whitney 2003). In the context of this Opinion, non-native fish are important because they are generally more tolerant of degraded conditions, i.e., warmer waters, compared to salmon and steelhead. Introduced species are frequently predators on native species, compete for food resources, and can alter freshwater habitats (e.g., carp).

There are 251,100 miles of perennial streams in the State of Washington. No statewide measurements exist of the area of riparian vegetation, although some estimates have been made for more localized regions. With the exception of fall Chinook, which generally spawn and rear in the mainstem, much salmon and steelhead spawning and rearing occurs in tributaries where riparian areas are usually forested. Land use activities over the past 150 to 200 years have reduced the numbers of large riparian trees, the amount of closed-canopy forests, and the proportion of older forests in riparian areas. In Washington, riparian plant communities have been altered along almost all of the major rivers and tributaries. Loss of riparian cover can allow local water temperatures to rise.

Beginning in the early 1800s, many of the riparian areas were extensively changed by human activities such as logging, mining, livestock grazing, agriculture, beaver removal, dams and water diversions, and development. Very little of the once-extensive riparian vegetation remains to maintain water quality and support habitats for threatened salmonids. Dams and diversions have adversely affected flow and sediment routing, which in turn have altered regeneration and natural succession of riparian vegetation along downstream rivers. Introduced plant species pose a risk to some riparian habitat by dominating local conditions and reducing the diversity of native plant species. Improper grazing in riparian areas is another threat that can lead to stream bank erosion. Today, riparian areas in many upper watersheds (largely on Federal lands) contain mature forests, while commercial timber lands contain younger riparian forests, and more than 80 percent of the mature forests have been lost along the lower rivers by years of human actions. The overall loss of mature riparian forests is believed to indicate less resilient and less productive conditions next to and within many aquatic habitats that developed with frequent inputs of leaves and sizeable boles.

In the Columbia River Basin, anadromous salmonids, especially those above Bonneville Dam, have been dramatically affected by the development and operation of the Federal Columbia River Power System. Storage dams have eliminated spawning and rearing habitat and have altered the natural hydrograph of the Snake and Columbia Rivers, decreasing spring and summer flows and increasing fall and winter flows. Power operations cause flow levels and river elevations to fluctuate, affecting fish movement through reservoirs and riparian ecology, and stranding fish in shallow areas. The eight dams in the migration corridor of the Snake and Columbia Rivers alter smolt and adult migrations. Dams also have converted the once-swift river into a series of slow-moving reservoirs that typically have warmer waters than without dams. Water velocities throughout the migration corridor now depend far more on volume runoff than before development of the mainstem reservoirs.

Even before mainstem dams were built, habitat was lost or severely damaged in small tributaries as a result of the construction and operation of irrigation dams and diversions; inundation of spawning areas by impoundments; and siltation and pollution from sewage, farming, logging, and mining (NMFS 2005c). 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.

Summary of Environmental Baseline

Based on the information summarized above, not all of the biological requirements of the listed species for freshwater habitat in general, water quality in particular, are being met under the environmental baseline in many streams and watersheds occupied by listed salmon and steelhead in Washington. Their status is such that there must be significant improvements in the environmental conditions they experience, over those currently available under the environmental baseline, to meet the biological requirements for survival and recovery of these species. Any further degradation of these conditions would significantly reduce the likelihood of survival and recovery of these species due to the status of the environmental baseline.

<u>Effects of the Action</u>

"Effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, which will be added to the environmental baseline. Indirect effects are those that occur later in time but that are reasonably likely 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" (50 CFR 402.02).

The EPA's approval of Washington's revised water quality standards will not have direct effects on ESA-listed species or their habitats, in that water quality standards merely define the goals that a given water body should attain in order to support the existing or designated uses that occur in that water body. However, approval of the standards may have significant indirect effects on listed species, because EPA's approval allows the State to implement the standards. EPA has very limited discretion, however, over the State's implementation activities. This analysis of the effects of the proposed action assumes that the species of interest are exposed to waters meeting the water quality standards; however, there are many waters in Washington that do not meet the current standards and would not meet the proposed standards. Without rigorous implementation by Ecology, it is unlikely that WQS would be attained on some stream segments that support ESA-listed fish. As Ecology completes TMDLs designed to meet the revised standards, issues or reissues permits in conjunction with those TMDLs, and incorporates nonpoint source controls adequate to meet water quality standards, the condition of impaired waters, and thus the environmental baseline, is likely to improve.

Effects on Fish

Proposed changes to the WQS will have effects on listed species only when the new standards are implemented. These effects are considered indirect, because they will occur later in time and are linked to implementation of restrictions in future discharge permits, voluntary incentive programs, and restoration activities. The CWA programs that may lead to indirect effects include section 303(d) listings, Total Maximum Daily Load (TMDL) management plans, NPDES permits, CWA section 401 certifications of federally licensed projects, and non-point source management plans designed to meet the water quality standards over time. Each of these types of programs is intended to control inputs of both point-source and non-point source pollution to water bodies such that the water quality standards are met in the receiving waters, and aquatic life is protected.

Approach to Effects Analysis. The analysis of the effects of the proposed action was conducted by evaluating the EPA's approval of the Washington State's 2006 WQS in the following manner:

- Determining if the proposed temperature and DO criteria themselves are adequate to protect the proposed uses;
- Determining if the standards are being applied in the appropriate areas and time of year to protect the proposed uses (spatial and temporal application across the landscape).

Adequacy of the Standards--Numeric Temperature Criteria for Salmonid Use Designations. Virtually all biological and ecological processes are affected by ambient water temperature. The protection and restoration of salmonid habitats requires that temperatures in streams and lakes remain within the natural range for the particular site and season. Most of the literature on salmonid temperature requirements refers to "preferred," "optimal," or "tolerable," temperatures or temperature ranges (e.g., Everest et al. 1985; Bell 1986; Bjornn and Reiser 1991; Welsh 1991; EPA 2003). The scientific rationale and basis for EPA's recommended criteria are described in the Temperature Guidance and the supporting six Technical Issue Papers (EPA 2001). The Temperature Guidance is a product of a three year interagency effort involving the Idaho Department of Environmental Quality, Oregon Department of Environmental Quality, Washington Department of Ecology, NMFS, U.S. Fish and Wildlife Service, Nez Perce Tribe, Columbia River Inter-Tribal Fish Commission, and EPA.

As stated, the Temperature Guidance includes the best available scientific information on the thermal requirements of Pacific salmon and outlines a regulatory structure to assure that those requirements continue to be met. The Temperature Guidance thus provides the starting point for evaluating state water temperature criteria, such that if the state's program is generally consistent with the Guidance, it is likely to be adequately protective of ESA-listed salmon and steelhead.

Table 7 below is copied from the Temperature Guidance. This table provides a summary of the important water temperature considerations for each life stage for salmon and steelhead. Each temperature consideration and associated temperature values noted in the table includes reference to the relevant technical issue papers prepared in support of the Temperature Guidance (or other studies) that support the values in the table. The temperatures noted in the table form the scientific basis for EPA's recommended numeric criteria to protect coldwater salmonids in the Pacific Northwest.

Although NMFS generally supports the Temperature Guidance, the application of the guidance is left up to the states. The Temperature Guidance (p. 27) states that the special application of the salmon and steelhead "Core rearing" temperature criteria (16° C) should be based on the following:

1. Waters with degraded habitat where high (and low) density juvenile salmon and steelhead rearing is known or suspected to occur during the summer months.
2. Waters with minimally degraded habitat where moderate to high density juvenile salmon and steelhead rearing is known or suspected to occur during the summer months.
3. Waters where steelhead egg incubation and fry emergence and salmon spawning occurs during the summer months (mid-June through mid-September).
4. Waters where juvenile rearing occurs and the 7-DADMax temperature is at or below 16° C (existing cold water).
5. Waters where adult and sub-adult bull trout foraging and migration occurs during the summer months (important to USFWS interests).
6. Waters where other information indicates the potential for moderate to high density salmon and steelhead rearing use during the summer (e.g. recovery plans, critical habitat designation, historical distribution, suitable habitat that is currently blocked by fish passage barriers that can be modified or removed).

Of the six criteria, EPA focused primarily on areas with documented Chinook spawning during the summer months, or where steelhead spawning occurred late in the spring which extended incubation into the summer.

Early in the consultation process among the Services and the Tribes with EPA, it became apparent that several of the criteria listed above (e.g. high density juvenile rearing, salmon and steelhead migration, and key recovery habitat) were difficult to apply because of lack of data, disagreement on whether it is more important to protect areas with high densities or low populations (areas with ESA listed fish), natural conditions, and defining "degraded" habitats, as well as other limitations.

Table 7. Summary of temperature considerations for salmon and steelhead life stages (from the Temperature Guidance (EPA 2003).

Life Stage	Temperature Consideration	Temperature & Unit	Reference
Spawning and Egg Incubation	Temperature range at which spawning is most frequently observed in the field Egg Incubation Studies - In good gravel - Optimal range Reduced viability of gametes in holding adults	4 – 14° C (daily avg.) 4 - 12E C (constant) 6 - 10° C (constant) 13E C (constant)	Issue Paper 1,[1] pp. 17-18 Issue Paper 5,[2] p. 81 Issue Paper 5, p. 16
Juvenile Rearing	Lethal temperature (1-week exposure) Optimal growth - Unlimited food - Limited food Rearing preference temperature in lab and field studies Impairment to smoltification Impairment to steelhead smoltification Disease risk (lab studies) - High - Elevated - Minimized	23 - 26E C (constant) 13 - 20E C (constant) 10 - 16 E C (constant) 10 - 17 E C (constant) <18E C (7-DADMax) 12 - 15E C (constant) >12E C (constant) >18 - 20E C (constant) 14 - 17E C (constant) 12 - 13E C (constant)	Issue Paper 5, pp. 12, 14 (Table 4), 17, and 83-84 Issue Paper 5, pp. 3-6 (Table 1), and 38-56 Issue Paper 1, p. 4 (Table 2) USEPA 2003 Issue Paper 5, pp. 7 and 57-65 Issue Paper 5, pp. 7 and 57-65 Issue Paper 4,[3] pp. 12-23
Adult Migration	Lethal temperature (1-week exposure) Migration blockage and migration delay Disease risk (lab studies) - High - Elevated - Minimized Adult swimming performance - Reduced - Optimal Overall reduction in migration fitness due to cumulative stresses	21 - 22E C (constant) 21 - 22E C (average) >18 - 20E C (constant) 14 - 17E C (constant) 12 - 13E C (constant) >20E C (constant) 15 - 19E C (constant) >17 - 18E C (prolonged exposure)	Issue Paper 5, pp. 17, 83-87 Issue Paper 5, pp. 9, 10, 72-74 Issue Paper 1, pp. 15-16 Issue Paper 4, pp. 12 - 23 Issue Paper 5, pp. 8, 9, 13, 65 - 71 Issue Paper 5, p. 74

[1] Sauter, S.T., J. McMillan, and J. Dunham. 2001. *Issue Paper 1: Salmonid Behavior and Water Temperature*. Prepared as part of USEPA Region 10 Temperature Water Quality Criteria Guidance Development Project.

[2] McCullough, D.A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. *Issue Paper 5: Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids.* EPA-910-D-01-005. U.S. Environmental Protection Agency. 114 pp.

[3] Materna, E. 2001. *Issue Paper 4: Temperature Interaction.* EPA-910-D-01-004. Prepared as part of the U.S. Environmental Protection Agency=s Region 10 Temperature Water Quality Criteria Guidance Development Project, Seattle, WA. 33 pp.

Washington's proposed WQS generally follow the recommendations outlined in the Temperature Guidance. However, there are several instances where "the multiple lines of evidence" used by the EPA (Appendix C of the BE) in determining appropriate temperature criteria for a given area resulted in standards less protective than recommended in the Temperature Guidance, particularly in the lower reaches of most of the major Puget Sound rivers. This will be discussed in more detail below.

Metric - Changing from a 1-Day Maximum to the 7-DADMax. How temperature is measured – or the temperature metric – is an integral aspect of the temperature numeric criteria. The metric is not independently assessed, but rather considered part of the effect assessment of the actual criteria. The discussion below explains how the change in metric from a daily maximum to a 7-DADMax temperature value is expected to effect attainment of the temperature criteria.

Ecology's proposed metric for measuring water temperature will affect the implementation of all freshwater aquatic life temperature criteria. Prior to the 2006 rule change, an instantaneous maximum temperature was used as the water temperature metric. The new metric, the 7-DADMax, is the measure of the maximum temperatures in a stream, averaged over a seven day period. This metric is not overly influenced by the maximum temperature of any single day and reflects an average temperature that fish are exposed to over a week-long period. While it is conceivable single day maximums that cause short unhealthy temperature exposures to salmon and trout could be masked by this new metric, it is unlikely to occur as a single day occurrence. Extreme temperature maximums strung in successive days would cause a 7-DADMax to exceed the criteria. The 7-DADMax metric is also protective of chronic effects to aquatic life (e.g. reduced growth) because the metric describes the thermal exposure over 7 days. The Temperature Guidance considered both acute and chronic effects to fish when developing its recommended temperature criteria.

The EPA states that studies have shown that the 7-DADMax temperature in Pacific Northwest salmon and steelhead streams is about 3° C higher than the weekly mean temperature. For example, a stream with a 7-DADMax of 18° C will generally have a weekly mean value of 15° C. Additionally, based on studies of fluctuating temperatures, EPA concluded that when the mean temperature is above the optimal growth temperature for salmon, the mid-point between the mean and maximum temperatures is the "equivalent" constant temperature. The "equivalent" constant temperature is the value that can be compared to the "constant" value temperature in the salmon studies. Therefore, in Pacific Northwest salmon and steelhead streams, which generally have a 3° C temperature differential between the 7-DADMax and the weekly mean, the 7-DADMax temperature can be translated to an "equivalent" constant temperature by subtracting 1.5° C (i.e., the mid-point between the 7-DADMax and the weekly mean). Conversely, a 7-DADMax temperature can be derived from a "constant" value temperature by adding 1.5° C to the "constant" value temperature. For example, the highest "constant" temperature that is considered protective of salmon and steelhead juvenile rearing, under limited food conditions, is 16° C. This translates to a 7-DADMax temperature of 17.5° C, which is the temperature standard that is applied to the migratory corridors and lower rivers (see Temperature Guidance, pages 19-20).

It is important to note that there are confounding variables related to in-stream temperatures that are difficult to account for but are important factors. For instance, the amount of diurnal variation in rivers and streams in the Pacific Northwest varies considerably and may be less than 1° C for rivers with little diurnal variation and as high as 9° C for streams with high diurnal variation (Temperature Guidance (EPA 2003)). Another variable is food availability. Studies indicate that temperatures for optimal growth are generally lower under conditions where the food supply is limited than in conditions where food is readily available. The EPA believes that laboratory studies where food availability is restricted are most reflective of environmental conditions. In conclusion, the 7-DADMax numeric criterion is more protective (than the old one-day exceedance criteria) in situations where there are high diurnal variation and/or abundant food, and will be less protective (than the old one-day exceedance criteria) in situations where there is low diurnal variation and limited food.

Effects on the Temperature Standard Resulting from Changing Water Quality Standard. The primary differences between the temperature criteria established in the 1997 WQS and the 2006 WQS are the change in metric (1-day max to 7-DADMax) and application of more stringent standards in areas with ESA listed fish. For water bodies where the 2006 standards are more stringent than the 1997 standards, the assumption is that the environmental baseline will improve over time. There are, however, two situations where the change may adversely affect environmental conditions. One is water bodies designated as "Core Summer Salmonid Habitat" use in the 2006 standards that were previously designated as "Class AA" in the 1997 standards and which are in attainment with the 1997 criteria. Changing the metric from a 1-day maximum to the 7-DADMax effectively would allow an increase of approximately 1° C in these water bodies. The second situation concerns river segments designated as "Salmon Spawning, Rearing, and Migration" use in the 2006 standards that were previously designated as "Class A" in the 1997 standards and which are in attainment with the 1997 criteria. In these cases, the temperature of the river segment could be increased by approximately 0.5° C.

However, NMFS has determined that it is very unlikely that the environmental baseline will be degraded as a result of approving the 2006 water quality standards for the following reasons:

1. Many of the lower rivers are currently not meeting the 1997 temperature standards and efforts are under way to address the factors that are contributing to warming. The new standards will not alter this effort.
2. Many of the water bodies that were previously designated as "Class AA" support ESA listed fish. In areas where salmon spawn during the summer or steelhead are emerging from the gravel in late spring, the more stringent 13° C spawning criterion will be applied. This will effectively keep the stream temperatures below the summer maximum criterion of 16° C.

3. Many of the rivers that are currently at or below the standards are in areas with established management programs in place that serve to minimize future degradation of water quality (e.g. Federal reserves or commercial forest lands).
4. The State's antidegradation requirements are applicable in situations where the 1997 standards are currently attained and the 2006 standards are less stringent, which will serve to minimize any degradation to these streams.

The discussion below summarizes the relative differences between 1997 and 2006 temperature standards. While the effects analysis in this Opinion will focus on the totality of the effects to listed species from EPA's approval of the proposed standards themselves and not on the incremental change from the 1997 to the 2006 standards, the discussion below provides context for assessing the proposed standards.

Ecology's 1997 water quality standards (1997 WQS) used a "Class-based" system which assigned each water body to a particular "Class." For example, freshwaters were assigned to Class AA, Class A, Class B, or Lake Class. Each "Class" contained a suite of beneficial uses (i.e., water supply uses, recreational uses, fish and shellfish use, etc.). In the 1997 WQS, temperature criteria were specified for each Class.

Table 8. 1997 Water Quality Criteria for Temperature.

Class	Use	Temperature Criteria[1]
Class AA (extraordinary)	Salmonid and other fish migration, rearing, spawning, and harvesting.	16° C
Class A (excellent)	Salmonid and other fish migration, rearing, spawning, and harvesting.	18° C
Class B (good)	Salmonid and other fish migration, rearing, and harvesting. Other fish spawning.	21° C
Lake Class	Salmonid and other fish migration, rearing, spawning, and harvesting.	No measurable change from natural

1. Represents daily maximum temperature.

The 2006 WQS revisions removed the "Class" system and instead applied the beneficial uses directly to specific water bodies. The general "fish and shellfish" use that was contained in each of the 1997 Classes was divided into specific aquatic life use categories in the 2006 WQS, and a new temperature criterion was adopted for each of these new aquatic life uses. The 2006 water quality standards revisions refined the "name" of the aquatic life use designations (as well as re-designated some water bodies). Table 9 below summarizes the new aquatic life designated uses and associated temperatures in the 2006 water quality standards revisions:

Table 9. 2006 WQS Aquatic Life Uses and Temperature applicable to ESA listed salmon and steelhead

Designated Use	Description	Highest 7-DADMax
Core Summer Salmonid Habitat	The key identifying characteristics of this use are summer (June 15 – September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and subadult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids. Note: Where Ecology determined the Core summer salmonid habitat criterion of 16° C would likely not result in protection of spawning and incubation the 13° C criterion was applied.	16° C 13° C
Salmonid Spawning, Rearing, and Migration	The key identifying characteristic of this use is salmon or steelhead spawning and emergence that only occurs outside of the summer season (September 16 -June 14). Other common characteristic aquatic life uses for waters in this category include rearing and migration by salmonids. Note: Where Ecology determined the Salmonid spawning, rearing, and migration criterion of 17.5° C would likely not result in protection of spawning and incubation the 13° C criterion was applied.	17.5° C 13° C
Salmonid Rearing and Migration only	The key identifying characteristic of this use is use only for rearing or migration by salmonids (not used for spawning).	17.5° C

The following describes the temperature changes that will occur when changing from the 1997 Class-based system to the proposed use-based system and applying the 7-DADMax metric rather than a one day maximum threshold.

Table 10. Temperature changes resulting from the new use designations and associated temperature criteria related to salmon and steelhead.

1997 Water Quality Standards		2006 Water Quality Standards		
Class	**Temperature criterion[1] (7-DADMax)**	**Use designation**	**Temperature criterion (7-DADMax)**	**Temperature change as a result of revised Water Quality Standards**
AA	15° C	Core summer salmonid habitat (approx. 30% of State)	16° C 13° C (part of year)	+ 1° C - 2° C (part of year)
A A	17° C 17° C	Salmonid spawning, rearing and migration (approx. 30% of State) Core summer salmonid habitat (approx. 15% of State)	17.5° C 13° C (part of year) 16° C 13° C (part of year)	+ 0.5° C - 4.0° C (part of year) - 1.0° C - 4.0° C (part of year)
B B	20 ° C 20 ° C	Salmonid rearing and migration only (approx. 5% of State) Salmonid spawning, rearing and migration (<1% of State)	17.5° C 17.5° C	- 2.5° C - 2.5° C
Lake Class	No measurable change from natural condition	Core summer salmonid habitat	Temperature increase can't exceed 0.3° C above natural conditions	No change from how Ecology implemented their 1997 standard

Notes
1. The temperature standards in the 1997 Water Quality Standards were expressed as a 1-day maximum temperature. Class AA had a temperature criterion of 16° C which is approximately equal to a 7-DADMax of 15° C; Class A had a temperature criterion of 18° C which is approximately equal to a 7-DADMax of 17° C; Class B had a temperature criterion of 21° C which is approximately equal to a 7 DADMax of 20° C.

Former Class AA Waters--Waters designated as Class AA in the 1997 WQS are designated as either "Char spawning and rearing" or "Core Summer Salmonid Habitat" in Washington's 2006 WQS. For waters that were formerly Class AA and are now designated as "Char," the temperature criterion will change from a daily maximum of 16° C to a 7-DADMax of 12° C. A daily max of 16° C is approximately equivalent to a 7-DADMax of 15° C. Therefore, the Class AA streams that are now "Char" will have approximately 3° C reduction in the allowable temperature. Approximately 20 percent of the State's streams fall into this category.

Waters that were formerly Class AA and are now designated "Core Summer Salmonid Habitat," will change from a daily maximum of 16° C to a 7-DADMax of 16° C. A daily maximum of 16° C is approximately equivalent to a 7-DADMax of 15° C. Therefore, the Class AA streams that are now designated as "Core" will have a 1° C allowable increase in temperature. Approximately 30 percent of the State's streams fall into this category. In general, these water bodies are located in the foothills of the Cascade Mountains, the Olympic Peninsula, and the Colville, Okanogan, and the Blue Mountains. The "Core Summer Salmonid" use designation is typically downstream from the "Char spawning and rearing" waters. In rivers where the 13° C criterion is applied during the late summer, the effective stream temperature will be below the 16° C 7-DADMax criterion. In order to attain the 13° C criterion, the seasonal temperature pattern necessitates that the summer maximum temperature be below 16° C. Examples where the 13° C criterion applies during the summer include most of the rivers on the Olympic Peninsula, the middle reaches of rivers that drain into Puget Sound, a few rivers in the east Cascades (Methow, Entiat, Naches, Wenatchee), and the Klickitat and Tucannon Rivers.

Former Class A Waters--Waters that were formerly Class A in the 1997 WQS are now either designated as "Salmonid Spawning, Rearing and Migration" or "Core Summer Salmonid Habitat" in Washington's 2006 WQS. For those waters designated as "Salmonid Spawning, Rearing and Migration," the temperature criterion will change from a daily maximum of 18° C to a 7-DADMax of 17.5° C. A daily max of 18° C would be approximately equivalent to a 7-DADMax of 17° C. Therefore, the Class A streams that are designated as "Salmonid spawning rearing and migration" will have approximately 0.5° C increase in the allowable temperature. The 13° C spawning criteria does not apply in most of these areas. Approximately, 30 percent of the State's streams fall into this category. The vast majority of these streams are in eastern Washington. The lower portions of several large rivers in western Washington also fall into this category (e.g., Stilliguamish, Snohomish, Duwamish, and Chehalis Rivers). In areas where the 13° C temperature criteria applies in the spring to protect steelhead spawning and incubation, the 2006 standards would be 2° C more stringent than the 1997 criteria (e.g., lower Stilliguamish, Chehalis, and Wenatchee Rivers). However, because most of the rivers are naturally cool in the winter and spring, applying the 13° C temperature criteria early in the year is not going to result in a substantial change.

For water bodies that were formerly Class A and are now designated "Core summer salmonid habitat," the temperature criterion will change from a daily maximum of 18° C (approximately 17° C 7-DADMax) to a 7-DADMax of 16° C. This will result in approximately a 1° C decrease in the allowable temperature. Approximately 15 percent of the streams fall into this category. This is the category of river segments that were designated as "Core summer salmonid habitat" as a result of EPA's 2006 disapproval action. Most of the river segments in this category are in lower elevation regions in western Washington and the Columbia Gorge.

Former Class B Waters--Most former Class B waters will be designated as "Salmonid rearing and migration only," but there are a few that were designated as "Salmonid spawning, rearing, and migration." In both of these cases the temperature criterion will change from a daily maximum of 21° C to a 7-DADMax of 17.5° C. A daily max of 21° C is approximately equivalent to a 7-DADMax of 20° C. Therefore, the former Class B streams will have approximately 2.5° C decrease in the allowable temperature. Approximately 5 percent of the State's streams are designated as "Salmonid rearing and migration only." Most of these streams are in eastern Washington, but a few are in western Washington (e.g., lower Duwamish River, lower Puyallup River, and lower Hoquiam River). Many of these rivers are used by ESA listed salmonids for migration.

Lake Class Waters--Lake Class waters will be designated as "Core summer salmonid habitat." The temperature criterion for Lake Class was "no measurable change from natural." In the new water quality standards, the temperature criterion is: "For lakes, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3° C above natural conditions." This does not represent a change from past practice, because Ecology interpreted its former "no measurable change" standard as a change of no more than 0.3° C.

Exposure Analysis. The primary focus of the analysis is to address the spatial and temporal application of the standards and effects of implementing the new temperature and DO criterion on salmonids. To evaluate the effects, NMFS looked at the population status of ESA listed salmon and steelhead in each ESU and DPS within the action area and the existing baseline conditions of the habitat with regards to water quality and considered whether the new standards will provide adequate protection for those ESUs and DPSs.

Temperature Standards--Washington's numeric temperature criteria are intended to generally be protective of the fresh water aquatic life uses. However, in some instances, early spawning salmonids may not be protected by these criteria. In these cases, more stringent spawning and incubation criteria are applied to protect these uses. The aquatic life uses and associated 7-day average daily maximum (7-DADMax) numeric temperature criteria outlined in Table 2 is summarized again below:

- Early (summer) Char Spawning 9° C (48.2° F)
- Char Use Designation 12° C (53.6° F)
- Early (summer) Salmon and trout spawning 13° C (55.4° F)
- Core Summer Salmonid Habitat designated use 16° C (60.8° F)
- Salmonid Rearing and Migration 17.5° C (63.5° F)

The three elements of the standards, "designated use," the associated "numeric criteria," and "location" of the designated use (i.e. the use designation that is assigned to a particular water body), are interrelated in their effect to salmonids as they dictate: the species and life history phase that is affected; the temperature that a particular species and life history are exposed to; and the location of that effect based on species distribution. The temporal and spatial application of the standards is illustrated on the maps in Appendix A of the BE.

1. Effects Determination for 9° C and 12° C Numeric Temperature Char Designated Waters--The EPA has determined that its approval of the char temperature criterion found in Table 200(1)(c) in WAC 173-201A-200(1)(c) will have no effect on Pacific salmon and steelhead. NMFS agrees. Application of 9° C to protect spawning bull trout or 12° C to protect bull trout feeding and migratory corridors is sufficiently protective of all salmon and steelhead life history stages as to prevent any adverse effects from these criteria (EPA 2003).

2. Effects Determination for 13° C and 16° C Numeric Temperature Criterion for Pacific Salmon Summer Core and Summer Spawning Designated Waters--Ecology adopted the 16E C 7-DADMax criterion as the general year-round criterion to protect waters designated for 'Core Summer Salmonid Habitat' use. This criterion is the same as that recommended in the Temperature Guidance (EPA 2003) for use by salmon/steelhead "Core" juvenile rearing life histories and also includes adult salmon holding use over the summer and adult and sub-adult bull trout foraging and migration use over the summer.

Ecology also adopted the 13° C 7-DADMax criterion that is applied at specific times and specific places to protect the salmon spawning and emergence life histories of this use if the natural decline in temperature was insufficient to protect these life histories.

The Temperature Guidance recommends a temperature of 13° C 7-DADMax (55° F) to protect salmon spawning. However, because salmon generally spawn in the late summer and fall, EPA indicated in the Temperature Guidance that it may be appropriate to protect a combined salmon spawning and rearing use with a single numeric temperature criterion that limits summer maximum temperatures. The justification for a single criterion is based on the temporal nature of thermal patterns in Washington streams/rivers. Data from Ecology (Washington Department of Ecology, 2005, Unpublished Data) indicate that in some Washington salmon-bearing waters where the summer maximum temperature is 16° C, temperatures will naturally decrease to levels that are protective of salmon spawning (i.e., 13° C) when spawning occurs in the mid-September or later. Also, temperatures will further decrease to protect egg incubation (6 to 10° C) during the winter.

However, according to EPA, there are some stream reaches designated "Core Summer Salmonid Habitat" use, where natural declines in water temperature (coincident with the onset of autumn spawning activity) are not adequate to protect salmon spawning (i.e., those with spawning starting in early to mid-September). An unpublished Ecology 2002 document supports this concern. A graph depicting the ability of a single temperature criterion to protect spawning (temperature achieving 13° C) illustrates only a 25–40 percent probability that 16° C waters will cool by the onset of spawning (at the 95 percent confidence interval). In most reaches with this use designation, salmon and steelhead spawn relatively early, e.g., mid-July through August. Therefore, dependence on natural temperature declines is insufficient to ensure adequately cold water for early spawners in these stream reaches. In these locations, the spawning criterion of 13° C (55.4° F) would protect salmon and steelhead spawning life history phases where this early spawning occurs. The 13° C criterion is also applied to waters where the fry of late season (spring) spawning steelhead emerge in summer, thus needing protection from warming summer conditions (Appendix A of the BE).

3. Protectiveness of 16° C Criteria and Effects Determination--Ecology adopted this criterion to protect the "Core Summer Salmonid Habitat" use (June 15 to September

15) which includes waters that support salmon and steelhead juvenile rearing and adult salmon holding over the summer. This numeric criterion applies during the warmest times of the summer, the warmest years, and throughout the water body, including the lowest downstream extent of the water body designated for this use, which means that the 7-DADMax temperatures will be cooler than 16° C most of the time where this use occurs. This is true because: (1) if the criterion is met during the summer maximum period, then temperatures will be colder than that value during the rest of the year; (2) the criterion must be attained at the furthest point downstream where this use is designated, and temperatures will generally be colder where the use occurs upstream due the effect of elevation on temperature; and (3) the criterion must be met in the warmest years, so that in most years, the waters will be colder.

Temperature requirements for the salmon and steelhead reproductive life history phases (i.e. holding of adults with mature gametes, spawning/fertilization, and embryo development to emergence) are generally less then16° C, based on available literature (see Table 7). Mature gametes within adult salmonids exposed to excessive temperatures can reduce fertilization success or embryo survival to emergence. Salmonid gamete viability is reduced at adult holding temperatures of greater than 16° C according to the EPA (2001). A literature review of Chinook and other salmonids found that temperatures 16° C and above are too warm (McCullough 1999) for the protection of gametes in holding Chinook salmon.

Of the various reproduction related life history phases of salmon/steelhead (maturation of gametes, spawning/fertilization, embryo development, hatching), the gamete maturation process in holding adults occurs earliest in time each summer. As previously stated, temperatures less than or equal to 13 to16° C are considered protective of holding adults with mature gametes (EPA 2001). The Temperature Guidance recommends 16° C for adults holding over the summer and 13° C for spawning. According to the BE, these two temperatures effectively bracket the period when some adults may hold with mature gametes. The EPA suggests that the decline of temperature with the onset of fall or the application of the 13° C criterion will result in exposure of salmon at this life history to temperatures that are protective. Table 11 below represents data from the WDFW SaSI database for Puget Sound (PS) Chinook. Table 11 is provided to demonstrate adult river entry and spawning times and is pertinent to the EPA's argument presented above. It is important to note the beginning and ending times of adult entry into their natal rivers. In most cases, some portion of the run may not be afforded adequate protection by either mechanism suggested by EPA above. Some populations of PS Chinook have life-history adaptations where pre-spawning adults begin entering the river in late spring or early summer and individuals within the population continue to enter throughout the summer months. For example, using Table 11, adult Elwha, White, Stillaguamish, Skagit and Nooksack River Chinook begin entering the river in late spring and continue through the middle of October in some cases. In the spring the streams are naturally cooled from

Table 11. Puget Sound Chinook ESU, river entry for adults, signifying periods of holding and spawn timing (from WDFW SaSI database).

Stock Name	River Entry Start	River Entry Stop	Spawn Start
NF/MF Nooksack	Late April	Mid–September	Late July
SF Nooksack	Mid–August	Late September	Late August
Mainstem Nooksack	Late August	Mid–October	Mid–September
Upper Skagit Mainstem/Tribs.	Mid–May	Early September	Late September
Lower Skagit Mainstem/Tribs.	Mid–July	Early October	Early September
Lower Sauk	Early July	Late September	Late August
Upper Sauk	Early June	Late September	Early July
Suiattle	Mid–April	Mid–July	Mid–July
Upper Cascade	Mid–April	Early August	Late July
NF Stillaguamish	Mid–June	Early September	Mid–August
SF Stillaguamish	Late August	Mid–October	Early September
Skykomish	Mid–August	Mid–September	Early September
Snoqualmie	Early October	Early November	Mid–September
N. Lk. Wash. Tribs	Mid–September	Early November	Late October
Issaquah	Mid–September	Early November	Late September
Cedar	Mid–September	Early November	Mid–September
Green	No data available	No data available	Mid–September
Puyallup	Late July	Late October	Mid–September
White / Puyallup Spring	Mid–May	Mid–September	Late August
White / Puyallup Fall	Early September	Early October	Early September
Nisqually	Early July	Late September	Mid–September
Skokomish	No data available	No data available	Mid–September
Dungeness	Mid–August	Mid–October	Early–August
Elwha	Late June	Mid–October	Late August

winter snow run-off. However, in many cases, rivers gradually warm as flows subside and daytime temperatures rise. Adults entering throughout the summer in these systems can be exposed to temperatures that would affect migration and gamete development. In addition, higher temperatures (greater than 16° C) during adult river immigration may cause outbreaks of disease. Water temperature greatly influences the immune system of fishes and the number and virulence of pathogens, particularly where large numbers of adults are holding. Pre-spawning adults holding in the lower Elwha, for example, are highly susceptible to *Dermocystidium* outbreaks. Rising water temperatures, coupled with limited adult holding areas (crowding), have caused significant numbers of pre-spawn mortalities.

Another example where adult migration within natal streams is not afforded protection from warmer temperatures is in the Yakima River. Adult spring Chinook must enter very warm water at the mouth of the Yakima in late April and continue in water exceeding 17.5° C through mid–July before they reach cooler waters nearer their spawning grounds. The EPA did not take action on the use designation and criteria on the Yakima River mainstem below the mouth of the Cle Elum River, because Ecology did not change site specific temperature criterion. Therefore, EPA did not include this aspect of Washington's water quality standards as part of the proposed action considered in this Opinion. However, the existing standards in this area constitute part of the environmental baseline, which is considered as part of the effects analysis in this Opinion.

Wenatchee River summer Chinook enter the river throughout June but do not spawn until late September. While the spawning areas are protected suitably with the 13° C spawning criteria, the standards for the adult migration and holding corridor is allowed to remain at higher thresholds (17.5° C 7-DADMax). Unless cold water refugia areas exist along the way for these migrating adults, gamete development can be impaired.

The 16° C temperature is protective of the "Core Summer Salmonid Habitat" because it is within the range of temperatures that are used by salmonid life histories specified under the designated uses listed by Ecology including, emergence, adult holding; summer rearing, and foraging by adult and sub-adult salmonids. The 16° C is not protective of the reproductive life history phases of fertilization, embryo development, and hatching unless spawning occurs late enough that the natural temperature decline results in sufficiently cool temperatures. However, in cases where spawning occurs relatively early, and the 13° C criteria is applied, the required decline in temperature standards protects this life history phase. This is discussed in the next section on the protectiveness of 13° C. Also, the 13° C criterion is applied into the spring where the 16° C would not be protective of late emerging steelhead fry.

The EPA determined in its BE that its approval of the "Core summer salmonid habitat" temperature criterion (16° C) is not likely to adversely affect the following ESUs/DPSs:

Chinook

- Snake River fall,
- Snake River spring/summer,
- upper Columbia River spring,
- lower Columbia River, and
- Puget Sound – except in specific reaches discussed below);

Steelhead

- Puget Sound – except in specific reaches discussed below),
- Snake River,

- Upper Columbia River,
- Middle Columbia River, and
- Lower Columbia River;

Chum
- Columbia River,
- Hood Canal summer run, and;

Coho
- Lower Columbia River.

Provided existing cold water is adequately protected (waters currently less than 16° C 7-DADMax), the criterion is applied in the times and places that the stated uses occur, and use of this criterion is expanded as appropriate as more data on salmon use in streams are collected, NMFS believes that this criterion is adequate to: (1) protect juvenile salmon and steelhead from lethal temperatures; (2) provide conditions during the period of summer maximum temperatures at the upper end of the optimal temperature range where food is limited for juvenile growth, thus providing optimal temperatures for other times of the year; (3) minimize temperature-induced elevated disease rates; and (4) provide a thermal regime that supports juvenile salmon and steelhead populations, as demonstrated by studies indicating moderate-to-high fish densities in waters within this thermal range (EPA 2003). Therefore, based on the consistency of this criterion with the Temperature Guidance, NMFS concurs with EPA's determination of "not likely to adversely affect." Snake River sockeye and Ozette Lake sockeye salmon would not be affected by approval of the subject criterion, because they do not occur in any of the waters where this criterion applies.

NMFS evaluated whether all waters in Washington State that have the designated use of "Core Summer Salmonid Habitat" were properly identified and designated. Besides the waters converted over from the old AA Class, Ecology included in this designation the reaches identified in the EPA fish data collected in 2005. As described above, the EPA used a process of: (1) developing a protocol for what types of fish use should be considered within this designated use category of "Core Summer Salmonid habitat"; (2) defining which water bodies had these fish uses from the best available GIS databases; (3) depicting all of these stream reaches on maps; (4) verifying the correctness of this distribution with local WDFW biologists; (5) modifying the use maps based on additional information gathered from Tribes and other organizations; and (6) receiving input on possible errors during a public review period and conducting a final update of maps.

Several stream reaches, which are questionable in terms of whether or not they meet the criteria for "Core Summer Salmonid Habitat" designated use, were not included by EPA (and therefore, not by Ecology). The reason for this exclusion was that data showing that these areas indeed supported the "Core Summer Salmonid Habitat' designated use were sparse or unsubstantiated. The EPA believed that future data collection as well as the possibility of range expansion by some species could result in a change of status in these stream reaches. Based on the lack of data, EPA has conservatively determined that lack of application of the 16° C criterion to these specific stream reaches is likely to adversely affect listed salmon and steelhead fish species. These stream reaches and the listed salmon and steelhead species that may be affected are listed in Table 12 below (provided by EPA in their BE).

Table 12. List of stream reaches with likely to adversely affect determination for Puget Sound Chinook and Puget Sound Steelhead. These reaches are not designated as "Core Summer Salmonid Habitat' use with associated 16° C temperature criteria but may have distribution of listed species during relevant life history phases to justify this use designation.

WRIA	Stream Name	Location	Listed species affected	Current Designated Use and Temperature Criterion	Comment
1	California Cr.	all	Puget Sound Steelhead,	'Salmonid Spawning, Rearing, and Migration' 17.5° C (no 13° C)	Limited information on steelhead spawning.
5	Stillaguamish River	from mouth to north and south forks (river mile 17.8)	Puget Sound Steelhead Puget Sound Chinook	'Salmonid Spawning, Rearing, and Migration' 17.5° C (13° C Oct. 1 – May 15)	Juvenile steelhead abundant in lower river throughout the year, including summer, some juvenile Chinook may be present.
7	Snohomish River	mouth to south tip of Ebey Island (RM 8.1)	Puget Sound Steelhead Puget Sound Chinook	'Salmonid Spawning, Rearing, and Migration' 17.5° C (no 13° C)	Juvenile steelhead abundant in lower river throughout the year, including summer, some juvenile Chinook may be present.
9	Duwamish River	mouth to Black R. confluence (rm 11.0)	Puget Sound Steelhead Puget Sound Chinook	'Salmonid Rearing and Migration Only'17.5° C (no 13° C)	Juvenile steelhead abundant in lower river throughout the year, including summer. Some juvenile Chinook may be present in summer.
9	Green River	Green R. from Black R. confl. (rm 11.0) upstream to RM 24.	Puget Sound Steelhead Puget Sound Chinook	'Salmonid Spawning Rearing and Migration' 17.5° C (no 13° C)	Juvenile steelhead abundant in lower river throughout the year, including summer. Some juvenile Chinook may be present in summer.
10	White River	Rm 0.0-4.0	Puget Sound Fall Chinook	'Salmonid Spawning, Rearing, and Migration' 17.5° C (no 13° C)	Early September Chinook spawning data is difficult to collect due to turbid conditions in mainstem glacial system [R. Ladley Pers. Comm. 12/13/04]. Low population numbers contributes to difficulty in obtaining spawning data. Suitable Chinook spawning habitat available in this reach. Adults must pass through reach to spawn above.

4. Protectiveness of 13° C Criteria and Effects Determination--Salmon/steelhead species spawn relatively early (e.g. late August and early September) in many waters of Washington. In these particular areas, Ecology determined that application of 13E C 7-DADMax criterion is needed to protect salmon/steelhead spawning use, as the natural decline of water temperatures in the autumn alone may be insufficient to yield adequately cold water for the spawning life history phase. Likewise, spring spawners that commence spawning activity late enough so that embryos could be exposed to warmer temperatures in the summer need to be protected with a specific criterion of 13° C to allow for successful fry emergence. Ecology has adopted a 13° C spawning and incubation criterion (WAC 173-201A-200(1)(c)(iv)) and has designated where and when this criterion is needed to protect spawning and incubation. These areas are described in Appendix C of EPA's BE, which is Ecology's publication number 06-10-038 "Waters Requiring Supplemental Spawning and Incubation Protection for Salmonid Species."

Ecology adopted this criterion to protect salmon and steelhead juvenile spawning through fry emergence. This criterion is recommended in the Temperature Guidance for this use. The diurnal variation when this criterion is applied is likely less than the diurnal variation in the summer so EPA believes that this 13 ° C 7-DADMax criterion would result in maximum weekly mean between 10 and 12° C for a typical stream. This criterion is designed to protect spawning, egg incubation, and fry emergence for salmon and steelhead. Meeting this criterion at the onset of spawning for salmon and at the end of incubation for steelhead will likely provide protective temperatures for egg incubation (6 to 10° C, 43 to 50° F)] that occurs over the winter (salmon) and spring (steelhead), assuming the typical annual thermal pattern.

According to the "Technical Synthesis of the Information Used to Develop the Temperature Guidance" (McCullough et al. 2001), anadromous salmon spawning is most frequently observed within a temperature range of 4 to 14° C and incubation is optimal between 6 and 10° C (Table 5-10). Exposure of eggs in ripe females or newly deposited in gravel and egg maturation are negatively affected by exposure to temperatures above approximately 12.5 to 14° C. A survey of temperature effects on spawning in fall-spawning salmonids found that the peak temperatures at spawning of spring/fall Chinook is 12.8° C, and that a declining temperature trend into the autumn would satisfy biological requirements for developing salmonid embryos.

Salmonid gamete viability is reduced at adult holding average temperatures of greater than 13 to 16° C according to the EPA (2001). Similar to the logic that 13° C applied at the beginning of the spawning period will likely result optimal (6 to 10° C) temperatures for egg incubation over the winter assuming the typical annual temperature pattern, the 13° C criterion also is likely to result in temperatures that are protective of gametes in ripe adults just prior to application date of the spawning criterion (average temperature less than 13° C and short term maximum temperatures less than 14 to 15° C).

The EPA determined that its approval of the 13° C criterion, found in Table 200(1)(c) in WAC 173-201A-200(1)(c), is not likely to adversely affect the following ESUs:

Chinook

- Snake River fall,
- Snake River spring/summer,
- Upper Columbia River spring,
- Lower Columbia River, and
- Puget Sound;

Steelhead

- Puget Sound,
- Snake River,
- Upper Columbia River,
- Middle Columbia River, and
- Lower Columbia River);

Chum

- Columbia River, and
- Hood Canal summer run

Coho

- Lower Columbia River.

Provided existing cold water areas are protected with the standard, the criterion is applied in the times and places that the stated uses occur (and as new information on salmon spawning is obtained, the use is expanded as appropriate), NMFS believes that this criterion is adequate to: (1) protect ripe gametes inside adults during the weeks just prior to spawning (less than 13° C constant); (2) provide temperatures at which spawning is most frequently observed in the field (4 to 14° C daily average); and (3) provide protective temperatures for egg incubation (4 to 12° C constant for good survival and 6 to 10° C constant for optimal range) that occurs over the winter (salmon) and spring (steelhead), assuming the typical annual thermal pattern. Therefore, based on the consistency of this criterion with the Temperature Guidance, NMFS concurs with EPA's determination of not likely to adversely affect. Snake River sockeye and Ozette Lake sockeye salmon would not be affected by approval of the subject criterion, because they do not occur in any of the waters where this criterion applies.

Ecology did not apply the 13° C criterion to several stream reaches where data were either sparse or unsubstantiated. Future data collection as well as the possibility of range expansion by some species could result in a change of status in these stream reaches. Based on the lack of data, the EPA has conservatively determined that lack of application of the 13° C criterion through the steelhead incubation/emergence period is likely to adversely affect listed Middle Columbia River steelhead in two stream reaches (Table 13). There is no firm documentation that steelhead spawn in these two stream reaches.

Table 13. List of stream reaches with, likely to adversely affect determination for listed Middle Columbia River steelhead. These reaches are not designated as "Core Summer Salmonid Habitat' use with associated 13° C temperature criteria but may have distribution of this listed species during spawning life history phases to justify this use designation with the associated 13° C temperature criterion.

WRIA	Stream Name	Location	Listed species present	Current Designated Use and Temperature Criterion	Comments
38	Tieton River	Mouth to reservoir	Middle Columbia River Steelhead	16 ° C Core Salmonid Summer habitat (no application of 13° C)	Steelhead spawning while suspected has not been documented at present time.
39	Upper Yakima River	Kachess confluence to Kechelus Reservoir	Middle Columbia River Steelhead	16 ° C Core Salmonid Summer habitat (13° C Sept 15 to May 15 to protect Chinook[1] spawning)	No data of steelhead spawning but EPA thinks it is likely 13° C to June 15 may be an appropriate future criteria.

[1]Note: Middle Columbia River Chinook are not a listed species.

5. *Protectiveness of 17.5° C Criteria And Effects Determination*--Ecology adopted 17.5° C 7-DADMax as the general year around criterion to protect waters designated for the 'Salmonid Spawning, Rearing, and Migration' use where spawning occurs after mid–September and egg emergence occurs before mid–June. In a few locations where salmon spawning starts in late September, Ecology also applied the 13° C criterion to protect the spawning life history phase of this use (e.g., lower Stillaguamish, Chehalis, and Wenatchee rivers).

The EPA indicated in the Temperature Guidance that it may be appropriate to protect a combined salmon spawning and rearing use with a single numeric temperature criterion (e.g., 17.5° C) that limits summer maximum temperatures. A review of the temperature patterns in Washington found streams with a 17.5° C summer maximum temperature are likely to cool to 13° C maximum temperatures by October but not before, (Ecology, March 2005) and, streams with a 17.5° C summer maximum temperature are likely to have 13° C maximum temperatures threshold for successful egg incubation at mid-June. Therefore, this designated use specifies the temporal limitation of the salmonid spawning and incubation life histories present in these water bodies. The 17.5° C is meant to be protective of salmonid spawning and incubation for waters where these life histories occur only in the October through mid-June period.

Information used to determine if the 17.5° C temperature criterion is protective of salmonid species is from the EPA Technical Synthesis (McCullough et al. 2001). In this synthesis of temperature literature, thermal temperature ranges important to juvenile salmon and steelhead include: lethal temperatures of 23 to 26° C, optimum growth with limited food temperatures of 10 to 16° C, preferred rearing temperatures of 10 to 17° C. Studies of thermal barriers to adult salmon migration indicate blockages occur at temperatures ranging from 18° C to 23.9° C (McCullough et al. 2001). Adult salmon migration studies indicate reduced migration fitness due to cumulative stress with prolonged exposure to greater than 17 to 18° C. Impairment of smoltification occurs at temperatures of 12 to 15° C for salmon and greater than 12° C for steelhead. Elevated disease risk for both rearing juveniles and migrating adults occur at temperatures ranging from 14 to 17° C. Increased stress, immune response, and virulence of the disease organism influence this temperature/disease relationship. Other behavioral characteristics can be influenced by elevated temperatures including interspecies competition occurring outside of the thermal optimum, which could pose a competitive disadvantage for the species with the lower thermal optimum. Elevated temperatures can also increase the feeding rate of predatory fish putting the prey species at a disadvantage. For example, predators of juvenile salmonids, such as northern pikeminnow (*Ptychocheilus oregonensis*), can increase feeding success on juvenile salmonids at elevated temperatures. Likewise many invasive fish species function best in cool water transition areas between cold water optimal for salmonids and warmer water optimal for warm-water fishes, resulting in increased predation of coldwater fishes (e.g. salmon and steelhead).

NMFS considers the 17.5° C temperature to be protective of salmonids based on the temperature ranges for life history activities associated with this designated use (Spence et al. 1996, and EPA 2003). Although some limited adverse effects are possible to individual fish (e.g., potential for elevated disease under an unusual situation where prolonged average exposure exceeds 15° C), EPA concluded that these possible adverse effects to salmon are discountable in Washington due to the limited application of this use/criterion in waters used by salmonids in the summer. In its BE, EPA concluded that its approval of the 17.5° C criterion applied to the "Salmonid Spawning, Rearing, and Migration" designated use is not likely to adversely affect (NLAA) the following ESUs and DPSs:

Chinook
- Snake River fall,
- Snake River spring/summer,
- Upper Columbia River spring,
- Lower Columbia River, and
- Puget Sound (except White River from mouth to river mile 4.0);

Steelhead
- Puget Sound (except California Creek),
- Snake River,
- Upper Columbia River,
- Middle Columbia River, and
- Lower Columbia River;

Chum
- Columbia River,
- Hood Canal summer run, and

Coho
- Lower Columbia River.

Provided the criterion is applied in the times and places that the stated uses occur, NMFS believes that this criterion is adequate to: (1) protect against lethal conditions for both juveniles and adults (21 to 22° C constant); (2) prevent migration blockage conditions for both juvenile and adults (21 to 22° C average); (3) provide sub-optimal juvenile growth conditions (under limited food conditions) during the summer maximum conditions, and optimal conditions during non-summer months of the year (10 to 16° C constant); and (4) minimize exposure time of adult and juvenile salmon and steelhead to temperatures that can lead to high disease risk (18 to 20° C constant). NMFS therefore concurs with EPA's determination of "not likely adversely affect," but with two limited exceptions, discussed further below. Snake River and Ozette Lake sockeye salmon would not be affected because this criterion does not apply to these ESUs.

Due to the likelihood of localized elevation of disease risk for some adult and juvenile salmon and steelhead, reduce viability of gametes in some holding adults, reduced growth of some juvenile salmon and steelhead, and increase predation potential with increased temperature, NMFS does not concur with EPA's NLAA determination in the following watersheds of two Chinook ESUs:

Puget Sound Chinook

- Stillaguamish River (River Mile 0 – River Mile 17.8),
- Snohomish River (River Mile 0 – River Mile 10),
- Snoqualmie River (River Mile 0 – River Mile 20),
- Green River (River Mile 11 – River Mile 24);

Lower Columbia River Chinook

- Grays River (River Mile 0 – River Mile 15.8)
- Kalama River (River Mile 0 – River Mile 2.0)
- Lewis River (River Mile 0 – River Mile 10)
- East Fork Lewis River (River Mile 0 – River Mile 6)

Studies of the migration timing and survival of adult Chinook support NMFS's concern that higher water temperatures can limit migration success. In some of the rivers listed above, Chinook begin entering the rivers when flows are higher and temperatures cooler, thus the early portion of the population can migrate to higher elevation and cooler stream temperatures before summer temperatures rise in the lower reaches. However, as illustrated in Table 14, adult Chinook are continuing to enter the river and pass through lower reaches (river miles listed above) during summer maximums, and these portions of the population are not afforded colder water protections. The later arrivals must rely on the presence of, and seek out cold water refugia (natural areas of cool tributaries, hyporheic inputs or deep pools) along their journey. If these areas do not exist, the warmer temperatures may affect the population's diversity, and potentially its spatial structure, which in turn would impact abundance and productivity of the population. Adverse effects may conceivably be so great on a population as to limit attainment of VSP.

Table 14. Chinook populations not protected by the 17.5° C temperature criteria. river entry for adult signifying periods of holding and spawn timing (from WDFW SaSI database).

Stock Name	River Entry Start	River Entry Stop	Spawn Start
Stillaguamish	June	October	Early September
Snohomish	Late July	September	Early September
Snoqualmie	Early October	Early November	Mid–September
Green	Data not available	Data not available	Mid–September
Grays	Mid–August	Early October	Late September
Kalama Fall Run	Early August	Early October	Late September
Lewis Fall Run	Early August	Early January	Early October
East Fork Lewis	Early August	Late November	Early October

In the Table above, most Chinook in these rivers are entering their natal river in July and August, during summer low flows and high temperatures. Chinook have evolved to refrain from eating for the duration of upstream migration. Completing migration requires adequate storage of lipids and protein to swim upstream and complete reproductive functions. The metabolic rate of fish will determine how long it takes to consume these energy reserves. Chinook metabolic rates are influenced by ambient water temperature. Warmer water temperature can adversely influence the survival of migrating adults directly by increasing the pace of their metabolic rate. Metabolic rate increases may cause adults to exhaust energy reserves affecting viable gamete development and spawning potential (Brett 1995). As discussed above, increased temperatures coupled with low flows and fish crowding can also cause stress which can lead to disease outbreaks (Spence et al. 1996).

The EPA acknowledges that the 17.5° C temperature is likely to adversely affect White River Chinook, identified by the Puget Sound Technical Recovery Team (TRT) as an independent population critical for recovery of the ESU (Ruckelshaus et al. 2006). Only a small segment of the White River has been designated "Salmonid Rearing and Migration." This section is from the mouth of the White River up to River Mile 4. Above River Mile 4 the White is designated "Core Summer Salmonid Habitat" and receives a 16° C protective standard. NMFS concurs with EPA's determination of affect for the White River Chinook. The portions of the White River spring adult Chinook run that enter the river later in the summer could be exposed to temperatures that may affect gamete development.

6. Special Temperature Criteria--Special temperature criteria are applied to certain river segments around the state and are identified in WAC 173-210A-602, Table 602. Table 602 in the Ecology standards lists water body segments and the designated uses and standards applicable to these segments. Table 602 also contains special temperature criteria that are applicable to specific stream segments. The EPA is not taking action on these special temperatures because these criteria have not changed from the previous standards; even though the designation of use did change, and EPA is approving the change in use. These special temperature criteria are:

- Columbia River from the mouth to the Grand Coulee dam – 20° C;

- Snake River from the mouth to the Washington/Idaho/Oregon border – 20° C;
- Yakima River from the mouthy to the Cle Elum River – 21° C;
- Skagit River from Gorge Dam to Gorge Powerhouse – 21° C;
- Palouse River from the south fork to the Idaho border – 20° C;
- Walla Walla River – 20° C;
- Pend Oreille River from the Canadian border to the Idaho border – 20° C; and,
- Spokane River from the mouth to Long Lake and from "Nine-mile bridge" to the Idaho border – 20° C.

Among the river segments listed above, the designated use for listed salmon and steelhead (salmonid spawning, rearing and migration; or, salmonid rearing and migration only – see Table 2 above) is not supported in the Walla Walla, Columbia, Snake, and Yakima rivers. ESUs and DPSs affected include Snake River fall and spring/summer Chinook, upper Columbia River spring Chinook, lower Columbia River Chinook, Snake River sockeye, Snake River steelhead, upper Columbia River steelhead, middle Columbia River steelhead, and lower Columbia River steelhead. The standards are disparate to the salmonid uses throughout these river segments and allow ecological functions and baseline conditions to remain impaired. The current temperature criteria are set at levels where adverse effects to listed salmonids would be expected.

7. Allowable 0.3° C Increase in Temperature in Waters Warmer than the Criteria--Ecology's water quality standards includes the following provision at WAC 173-201A-200(1)(c)(i):

> "When a water body's temperature is warmer than the criteria in Table 200 (1)(c) (or within 0.3º C (0.54º F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3º C (0.54º F)."

Additionally, the Ecology water quality standards contains a provision which allows the natural condition of the water body to become the criterion when the natural condition of the water body is of lower quality than the criterion assigned in the State's water quality standards (see WAC 173-201A-210A-310(3)). There is no provision in the standards that allows the natural condition of the water body to become the standard if the natural condition is higher quality then the assigned criterion. The above provision is consistent with the recommendations in the Temperature Guidance, which discusses allowing the temperature in a water body to be insignificantly higher than the applicable criteria. The purpose of such a provision is to allow an insignificant level of heat into the river from human activities when the natural conditions criteria is the applicable criteria or where waters are currently exceeding the biologically-based numeric criteria. Absent such a provision, no heat would be allowed from human activities when the natural condition criteria are the applicable criteria. The EPA has concluded that this result is unnecessarily restrictive for protection of salmonid uses and would lead to unnecessary cost, therefore the EPA recommended such a provision in the Temperature Guidance. Furthermore, the EPA asserts that this provision does not undermine the protection of uses provided by the natural conditions criteria.

The EPA determined that a 0.3° C or less temperature increase above the natural condition temperature is insignificant; however, EPA determined that the subject criterion is likely to adversely affect the subject listed salmonids. The EPA recognized, and NMFS concurs, that temperatures within the mixing zone of some National Pollutant Discharge Elimination System (NPDES) discharges may result in temperatures near the vicinity of the discharge that may adversely affect salmonids (see *NPDES Implementation* below). Heightened temperatures increase the likelihood of elevated disease risk for some adult and juvenile salmon and steelhead, and slightly reduce growth and survival of some juvenile salmon and steelhead, particularly within temperature mixing zones. Rapid temperature gradient differences in a river can cause thermal blockages to upstream and downstream migration of juvenile and adult salmon and steelhead. The Ecology rule does not have temperature thermal plume limitations that are specific to protect salmon and steelhead spawning from point source discharges if the spawning is not protected by that designated use criteria.

8. Protecting Cold Water--Ecology's regulatory process, in combination with natural physical processes could be used to ensure that many of the State's waters will be maintained at temperatures well below the established criteria. However, the standards elsewhere allow for a 2.8° C increase in water temperature from non-point sources per 173-201A-200(1)(c)(ii)(B). Under this provision waters that are currently colder than the standards could be warmed by up to 2.8° C or the standard (whichever is lower).

The three regulatory provisions described in the three bullets below for protecting existing uses can be applied to protect areas within water bodies that have aquatic life uses that are unique to the overall water body. For example, where cold water tributaries or ground water emergence zones exist, these areas may support uses that are unique in that water body. Once documented, the narrative provisions for protecting the uses that rely on these cold water areas can be invoked on a site-specific basis without having to go through rulemaking, but can also serve to provide interim protection while formal designation of the cold water area occurs during a rulemaking process.

- Incremental Warming Criteria. Ecology's temperature criteria include limits on the amount of incremental warming that any regulated source (point source) can cause in waters that are colder than the established criteria. An equation that produces an allowable increment of warming based on the level of background temperature is included in the standards (WAC 173-201 A-200(ii)) and restated below:

  (ii) When the natural condition of the water is cooler than the criteria in Table 200 (1)(c), the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows:

    (A) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 28/(T+7) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);

The EPA proposes to approve the allowable temperature increase of 28/T+7, at the edge of a mixing zone, for point source dischargers when the natural condition of a water body is cooler than the numeric temperature criteria contained in Table 2 (Table 200(1)(c) in the WAC). Table 200(1)(c) (WAC 173-201A) establishes the temperature criteria protective of aquatic life. The EPA has reviewed and proposes to approve the criteria in Table 200(1)(c). The incremental temperature increase limits the temperature increase a point source can cause to a water body which is cooler than the established temperature criterion, and it does not allow the temperature to increase above the criteria established in the table to protect aquatic life uses.

NMFS is concerned that these allowable increases would allow colder waters to warm to the designated use criteria. The Union River (WRIA 15) is one example. This river supports Hood Canal summer-run chum salmon. During summer maximum temperatures, this river is much cooler than the standard. Summer-run chum begin entering the Union in mid–August. Allowing this river to incrementally warm up to the standard may substantially delay chum returns, impair incubation, and affect life history adaptations and perhaps VSP parameters for this stock.

- Cumulative 0.3° C in Lakes. In all lakes, the state standards set a cumulative warming allowance of 0.3° C for all human activities combined (WAC 173-201A-200(v). Thus naturally cold lakes and any cold thermo-cline regions of lakes are maintained at essentially their natural potential condition. (This is discussed in greater detail below).

- Antidegradation. As described below, the state has three antidegradation tiers that can be used to protect waters that are currently colder than the designated temperature criteria. Each tier has different applications and strengths.

  Tier I. Tier I regulations include a provision directing that protecting uses takes precedence over just applying numeric criteria. WAC 173-201A-310(1) reads:

  "Existing and designated uses must be maintained and protected. No degradation may be allowed that would interfere with, or become injurious to, existing or designated uses, except as provided for in this chapter."

  Tier I is further strengthened by language directing that:

  "The department will establish water quality requirements for water bodies in addition to those specifically listed in this chapter on a case-specific basis where determined necessary to provide full support for designated and existing uses." WAC 173-201 A-260(3)(a).

Tier II. Tier II regulations are meant to protect waters of higher quality than the standards. WAC 173-201A-320(1) states: “Whenever a water quality constituent is of higher quality than a criterion designated for that water under this chapter, new or expanded actions within the categories identified in subsection (2) of this section that are expected to cause a measurable change in the quality of the water may not be allowed unless the department determines that the lowering of water quality is necessary and in the overriding public interest.”

In the context of this regulation, a measurable change includes a temperature increase of 0.3° C or greater and a DO decrease of 0.2 mg/L or greater.

The regulatory requirements for Ecology’s Tier II are among the most stringent in the nation when it comes to protecting temperature criteria. All actions that Ecology *has regulatory authority over* (e.g., NPDES permits, forest practices permits, 401 certifications) must go through a Tier II evaluation. For example, any action that could warm temperatures by more than 0.3° C at the edge of a mixing zone would need to go through a comprehensive examination of non-degrading or less degrading alternatives, and the applicant would be required to adopt those alternatives that are technically and economically feasible. Prior to obtaining approval, the entity must also conduct an analysis that shows that the economic and social benefits are larger than the economic, social, and environmental costs of allowing any necessary degradation. In many cases, the Tier II evaluation is expected to identify alternatives that will lessen or even eliminate the thermal warming of waters during the summer months. Thus Tier II will have the effect of protecting existing waters at temperature below water quality criteria.

Tier III. Ecology’s Tier III establishes two stringent levels of water quality protection that will protect waters at temperatures lower than the established water quality criteria. Waters that were formally designated as Tier III(A) would receive non-degradation protection and waters that were formerly designated by name into the Tier III(B) category would only be allowed to be degraded by cumulative (all human sources combined) 0.3° C from existing conditions. Both Tier III(A) and Tier III(B) are available for waters in national and state parks, monuments, preserves, wildlife refuges, wilderness areas, marine sanctuaries, wild and scenic rivers, etc. Additionally, Tier III protection is specifically allowed for waters serving as important cold water refugia. To encourage the adoption of Tier III protection based only on the use as a cold water refuge, Ecology’s regulations allow the application of Tier III protection to just temperature and dissolved oxygen in this particular case. This approach removes some of the political and administrative opposition that would be associated with requiring prohibitions on all forms of pollutants in waters whose special value was its use as thermal refugia. This will particularly be important where the refugia nominated for protection occurs in mainstem waters where a multitude of human actions occurs upstream. There are currently no streams in Washington that are protected under Tier III.

9. Natural Physical Processes--Cooler upstream waters are needed to meet downstream criteria. Temperatures naturally increase as water moves downstream. While this general pattern can be altered by very cold and large tributaries or large springs, it is a dependable physical process with the water moving towards equilibrium with air temperature. Since temperature criteria apply to all portions of a water body, the application of these criterion to the lower reaches of a water body means that more stringent thermal protection is needed upstream than just meeting the assigned criteria. Thermal controls in upstream reaches must be sufficient such that even when taking into account the natural process of warming as water moves downstream, those downstream reaches will also remain in compliance. Thus upstream areas must be maintained at temperatures below the maximum state water quality criteria in order for the water body as a whole to comply with the State WQS.

While not every mechanism for protecting existing cold waters applies to every water body in the State, according to EPA, most of these mechanisms are uniformly applied, and most of the others were developed specifically to target protection of the types of waters where cold waters are found. Thus, taken in total, the WQS and implementation programs could provide for waters throughout the state maintained at temperatures at or below the standards.

10. National Pollutant Discharge Elimination System Implementation--Under the NPDES program, all facilities that discharge pollutants from any point source into waters of the United States are required to obtain an NPDES permit. NPDES permits contain conditions that limit the amount of a pollutant that may be discharged to surface waters. After analyzing the effect of a discharge on the receiving water, a permit writer may find that effluent limits are needed to ensure that the discharge does cause or contribute to an exceedance of the state's WQS.

The State's WQS are composed of three components: (1) use classifications; (2) numeric or narrative water quality criteria deemed necessary to support the use classification; and (3) an antidegradation policy. Federal regulations at 40 CFR 122.44(d) require permits to contain conditions necessary to achieve the WQS. To evaluate the effect that the discharger has on the receiving water body, a permit writer must use the State's WQS, the allowable mixing zone, and a method for predicting impacts to surface waters, and defining effluent limits for numeric criteria.

By definition, the mixing zone is an area near the discharge outfall where the WQS can be exceeded. However, the mixing zone should be small enough so that it does not interfere with the beneficial uses of the water, and the temperature criterion for that water body must be met at the edge of the mixing zone. In Washington, mixing zones for rivers and streams must comply with the following conditions:

- mixing zones may not extend in a downstream direction more than 300 feet plus the depth of the water over the discharge port, or extend upstream for a distance of over 100 feet upstream from the diffuser;

- mixing zones may not use more than 25 percent of the flow (note: this dilution is determined by taking 25 percent of the 7-day average low flow with a return period of 10 years (7Q10); and

- mixing zones may not occupy more than 25 percent of the cross-sectional area of the water body.

Any facility whose discharge temperature would increase the temperature at the edge of the mixing zone by more than the specified amount allowed in the permit likely would exceed the WQS. Therefore, an effluent limit for temperature would need to be incorporated into the permit to ensure that the temperature standard was met at the edge of the mixing zone. Facilities whose discharge temperature would increase the temperature at the edge of the mixing zone by an amount equal to or greater than 0.3° C are required to complete a Tier II antidegradation analysis, as described under the cold water protection provisions.

In a water body that is already temperature-impaired, an individual point source may increase the temperature by 0.3° C above the applicable criteria within the mixing zone (25 percent of the river). Theoretically, if five or more point sources were all discharging into a river at or near the same location, it is possible for the cumulative temperature increase to be more than 0.3° C. Although possible, the EPA is not aware of such a situation and believes that NPDES discharges are spaced far enough apart that this cumulative impact would be discountable. For purposes of calculating an NPDES effluent limit, the permit writer generally assumes that the upstream temperature is exactly at the numeric criterion (e.g., assumed to be at the 17.5° C numeric criterion even if the current river temperature is 19° C). Assuming this, it is then possible to calculate, using a mass-balance equation and the river and point source discharge flow rates, the effluent discharge temperature that would result in the river temperature increasing by 0.075 ° C. The result of this approach is that the NPDES limit is established in such a way that the point source meets the water quality standard even if the river itself exceeds the standard due to other sources. Eventually, as non-point sources are reduced and other NPDES sources are limited in a similar way, EPA expects the river would attain WQS.

The EPA believes that a 0.3° C or less temperature increase is insignificant for two reasons. First, monitoring measurement error for recording instruments typically used in field studies is about 0.2 to 0.3° C. In other words, this level of a temperature increase is considered undetectable with typical temperature monitors. Second, a 0.3° C temperature difference is well within the range of uncertainty of our understanding of the thermal requirements of salmonids, which are in the range of ±0.5° C.

However, as discussed above, mixing zones with heightened temperatures increases the possibility of elevated disease risk for some adult and juvenile salmon and steelhead, and can reduce growth and survival of some juvenile salmon and steelhead within the temperature mixing zones. Also, substantial temperature gradient differences in a river can cause thermal blockages to upstream and downstream migration of juvenile and adult salmon and steelhead. Also as previously mentioned, the Ecology rule does not have temperature thermal plume limitations that are specific to protect salmon and steelhead spawning from point source discharges if the spawning is not protected by that designated use criteria.

11. Allowable Warming in Mixing Zones--Ecology's WQS include the following provisions for mixing zones:

> "When the natural condition of the water is cooler than the criteria in Tables 200, 210 (1)(c), the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows:
>
> > (A) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 28/(T+7) for freshwater or 12/(T-2) in the marine environment, as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);"

As stated above, EPA proposes to approve the allowable temperature increase at the edge of a mixing zone, for point source dischargers when the natural condition of a water body is cooler than the numeric temperature criteria. However, the permitted increase cannot exceed the criteria established to protect the existing aquatic life use for that water body. Ecology's anti-degradation policy requires that a Tier II analysis be completed for any State regulated new or expanded action, such as point source discharges, that would warm temperatures by 0.3° C or more at the edge of the mixing zone. Therefore, a Tier II analysis would have to be completed if the incremental temperature increase resulted in an increase of 0.3° C or more at the edge of the mixing zone for point sources.

As stated above, the EPA recognizes that temperatures within the mixing zone of some NPDES discharges could result in temperatures near the vicinity of the discharge that may adversely affect salmon and steelhead. Because this provision would authorize thermal discharges that could be harmful to listed salmonids, the EPA has concluded that its approval of this provision is likely to adversely affect listed salmon and steelhead in Washington.

Acute thermal shock leading to death can be induced by rapid shifts in temperature (McCullough 1999) above the fish's acclimation temperature. The effect of the shock depends on acclimation temperature, the magnitude of the temperature shift, and exposure time (Tang et al. 1987, Myrick and Cech 2004). Thermal shock can also indirectly increase mortality. Juvenile Chinook salmon and rainbow trout acclimated to 15 to 16° C and transferred to temperature baths in the range of 26 to 30° C suffered significantly greater predation than controls (Coutant 1973, Myrick and Cech 2004)).

Coho salmon and steelhead acclimated to 10° C and transferred to 20° C water suffered sublethal physiological changes, including perturbations in carbohydrate metabolism leading to hyperglycemia, increased hepatic metabolism leading to hypocholesterolemia[8], increased blood hemoglobin, and decreased blood sugar regulatory precision (Wedemeyer 1973). Based on this information, sublethal adverse effects from shifts of 10° C shock are possible for salmon and steelhead that enter the thermal plume of a mixing zone. The mixing zone provision limits thermal shock to that which occurs in 5 percent (acute area of the mixing zone) of the cross section of the 7Q10 low flow of the water body. Although this is consistent with the Temperature Guidance, it does not completely avoid adverse effects.

The thermal plume provision (within the acute portion of the mixing zone) and size of the mixing zone limits potential migration blockage conditions to less than 25 percent of the cross-sectional area of the 7Q10 low flow of the water body. Given these restrictions, theoretically, fish can go around or move through the mixing zone without any impairment of migration. Salmonids are sensitive to temperature gradients of about 0.1° C.

Although NMFS agrees that the large scale and cumulative effects from point source discharges may be insignificant, there is a potential that salmon and steelhead that linger near the end of the discharge or spend a significant amount of time in or near mixing zones may be subjected to temperatures that could result in thermal stress (sublethal harm) or alterations of normal feeding and migratory behavior (avoiding the mixing zone). Potential adverse effects in the form of harm through significant impairment of behavioral patterns could occur within the mixing zone from direct exposure to elevated temperatures. However, if fish have the opportunity to avoid a mixing zone, that is, mixing zones are modeled and implemented successfully, NMFS believes it is possible these adverse effects are of a magnitude, extent or duration that would pose a an insignificant risk to salmon and steelhead. At a minimum, however, mixing zones would reduce usable habitat for salmonids.

12. Allowable Temperature Increases For Lakes--Ecology's water quality standards include the following criteria for lakes:

> "(v) For lakes, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3° C (0.54° F) above natural conditions."

The above provision is consistent with the recommendations the Temperature Guidance, which discusses allowing the temperature in a water body to be insignificantly higher than the applicable criteria. The purpose of such a provision is to allow an insignificant level of heat into the water body related to human activities when the natural conditions criteria is the applicable criteria or where waters are currently exceeding the biologically-based numeric criteria. Absent such a provision, no heat would be allowed from human activities when the natural condition criterion is the applicable criteria. NMFS believes that this provision does not undermine the protection of uses provided by the natural

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[8] Reduction in plasma cholesterol levels.

conditions criteria. The 0.3° C or less temperature increase is insignificant for two reasons. First, monitoring measurement error for recording instruments typically used in field studies is about 0.2 to 0.3° C. In other words, this level of a temperature increase is considered undetectable with typical temperature monitors. Second, a 0.3° C temperature difference is well within the range of uncertainty of our understanding of the thermal requirements of salmonids, which are in the range of ±0.5° C.

13. Antidegradation--Section 303 of the Clean Water Act (CWA) requires states and authorized Indian tribes to adopt WQS, including antidegradation provisions consistent with the regulations at 40 CFR 131.12. Under these rules, states and authorized Indian tribes are required to adopt antidegradation policies to provide three levels of water quality protection and identify implementation methods. The first level of protection (Tier 1) requires the maintenance and protection of existing instream water uses and the level of water quality necessary to protect those existing uses. Existing uses are "...those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the WQS" (40 CFR 131.3(e)). The second level of protection (Tier 2) is for high quality waters, which are waters where the quality is better than the levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water ("fishable/swimmable" uses). This high quality is to be maintained and protected unless, through a public process, some lowering of water quality is deemed to be necessary to accommodate important economic or social development to occur in the area of the lowering. Activities such as new or increased discharges would presumably lower water quality and would not be permissible unless the State conducts a Tier II review. The third and highest level of protection (Tier 3) is for Outstanding National Resource Water (ONRWs). If a state or authorized tribe determines that the characteristics of a water body constitute an ONRW, such as waters of exceptional recreational or ecological significance, and designates a water body as such, then those characteristics must be maintained and protected.

The antidegradation provision is beneficial to listed species because it provides a layer of protection for waters that are currently colder than the criteria. Waters designated as Tier III for temperature would not be allowed to be degraded (except for de minimis amounts for Tier III(B). Additionally, a Tier II analysis as described in WAC 173-201A-320 would be required for certain types of new and expanded actions in Tier II waters.

Dissolved Oxygen Standards. The EPA is proposing to approve the 9.5 mg/L DO criteria for water bodies that were previously designated Class A or Class AA and are designated as *Core Summer salmonid spawning and rearing* under the 2006 WQ rule revisions. The EPA has concluded that approval of the DO criteria is likely to cause adverse effects, because the new standard, although it is more protective than the old criterion (see Table 3, particularly converting Class A designation to Core), may still not be protective enough for incubation and fry emergence. The DO supply for embryos and larvae can be depleted even when the DO concentration in the overlying body of water is otherwise acceptable. Inter-gravel dissolved oxygen (IGDO) is dependent upon the balance between the combined respiration of gravel-dwelling organisms (from all aquatic biota of bacteria to fish embryo), and the rate of DO supply (which is dependent upon rates of water percolation and convection, and DO diffusion (EPA 1986, Spence et al. 1996, Groot and Margolis 1998)).

Early life stages of fish, specifically the developing embryo, are very sensitive to reduced oxygen levels. The scientific literature suggests that embryo survival drops markedly as IGDO concentrations fall below 8 mg/L and is close to zero at 5 mg/L. Depending on the water temperature and permeability of the gravels, EPA (1986) has determined that there is an average 3 mg/L drop in DO levels between the water column and the gravel where fish eggs are deposited. Given this, the 9.5 mg/L DO criterion (measured in the water column) potentially relates to an IGDO level of 6.5 mg/L (or less in areas where there is more than a 3mg/L drop in DO between the water column and the IGDO). This level would result in significant adverse effects to egg survival and embryo development.

The EPA is proposing to approve the 9.5 mg/L DO criteria for the "new" Core waters and four other small water bodies noted above. There is no action for the 9.5 mg/L DO criteria for the other Core (& Char) waters because the criteria for theses waters are unchanged. Thus, the approval action would cover about 15 percent of the waters in the state, mostly in Puget Sound and lower Columbia River regions.

The Puget Sound Chinook and lower Columbia River Chinook are the ESUs with the highest potential for any effects because of the significant overlap of the "new Core" waters and the spawning distribution of these species. Only a few water bodies will have revised DO criteria in the Hood Canal region (Hood Canal summer chum), and the eastside of the Cascades (mid-Columbia steelhead, upper Columbia Chinook).

As previously mentioned, the revised DO criteria for these waters will be more stringent, changing from 8.0 mg/L to 9.5 mg/L. However, NMFS believes the 9.5 DO criterion does not provide adequate overall protection of incubating eggs. NMFS believes there are scenarios where potential adverse effects are likely. For example, where spawning occurs in low gradient reaches, or where gravels contain finer sediments, or where redds may be superimposed, percolation rates of the DO from the water column to the embryos buried in the gravel can be greatly reduced. Higher concentrations of DO in the water column may ameliorate this concern as more IGDO would be infused around developing embryos.

DO concentrations of 9.5 mg/L as an absolute minimum during the time of year when DO is lowest (late summer), would provide an excellent level of protection during the non-incubation (rearing/migration) period and would likely result in DO concentrations higher than 11 mg/L or 95 percent saturation during most incubation periods. Data indicate that the lowest values are in the late summer and higher concentration throughout the rest of the year (Ecology 2005, or Ecology’s website at: ecy.wa.gov/biblio). The EPA analyzed data from over 60 monitoring stations for the "new Core" waters that showed that attaining 9.5 mg/L results 11 mg/L or higher than 95 percent saturation during incubation in most cases. In 49 out of 60 stations that attained 9.5 mg/L, 11 mg/L or 95 percent saturation was attained throughout the incubation period. For 11 stations, there were samples in the record during incubation that dropped below 95 percent saturation during incubation (these were generally in the 90 to 95 percent range during the first few weeks of incubation).

Antidegration provisions (discussed above) are designed to protect the high DO levels (higher than 9.5 mg/L) that currently exist throughout the year.

While NMFS agrees with the above assumptions, there are scenarios where the 9.5 mg/L criterion could (and does) result in DO levels below 11 mg/L or saturation during part of the incubation period. Levels lower than the saturation potential during incubation would likely result in some level on impairment/take (some embryos and fry that might not develop and smaller fry that are less competitive). This assumes DO in the gravels does drop below 8 mg/L for a period of time, based on an EPA study (EPA 1986) that IGDO is generally 3mg/L less than the water column DO.

Ecology believes that the EPA study (EPA 1986) may not accurately depict conditions in Washington State, and that the 9.5 mg/L DO standard should be adequate. Ecology maintains that the 3mg/L differential is more than expected in Washington. However there are little supporting data, and Ecology has agreed to conduct a three-year study, which is currently in progress, to determine if the 9.5 mg/L DO (water column) standard will need to be revised. Ecology has agreed to begin a rulemaking process in mid-2008 if results of the study (which are expected in 2008) indicate that the DO criteria should be increased to provide adequate IGDO levels for spawning, incubation, and fry emergence (Ecology April 7, 2007 letter to EPA).

Exemptions on Total Dissolved Gas for the Snake and Columbia Rivers. Ecology's water quality standards includes the following provision at WAC 173-201A-200(1)(f)(ii):

> "(ii) …The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:
>
> 1. The TDG must not exceed an average of one hundred fifteen percent (115 percent) as measured in the forebays of the next downstream dams and must not exceed an average of one hundred twenty percent (120 percent) as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure); and
> 2. A maximum TDG one hour average of one hundred twenty-five percent (125 percent) must not be exceeded during spillage for fish passage."

The EPA is proposing to approve the special fish passage exemptions for the Snake and Columbia rivers. The Army Corps of Engineers (COE) is authorized under Federal statutes to operate eight hydroelectric projects on the lower Columbia and lower Snake rivers that provide passage for migratory fish species. Since 1992, NMFS has prepared several Biological Opinions on operation of the Columbia/Snake hydro system which call for project spill in the spring and summer to aid juvenile fish passage. The spill levels needed to protect ESA-listed fish often result in exceedances of the Oregon and Washington WQS of 110 percent for TDG saturation.

Effects – Total Dissolved Gas and Fish Physiology--Atmospheric air at sea level is comprised of 80 percent nitrogen, 20 percent oxygen and trace amounts of other gases. These gases are water soluble and reach an equilibrium steady state reflecting several physical factors. The solubility of air is directly proportional to the ambient pressure (barometric and hydrostatic) and inversely proportional to water temperature. Air gases pass in or out of solution at the air/water interface. Spills at hydroelectric dams dramatically increase the air/water interface as the water passes over the spillway and plunges with great force into the pool below the dam. The momentum of the spilled water carries air instantaneously to great depths, effectively increasing the hydrostatic pressure two to three-fold over levels that would occur naturally. This significant increase in the solubility of the gases results in the water becoming supersaturated.

Waters below a spilling dam are turbulent and highly aerated. Some of the gas that was forced into solution under pressure will quickly be released in this aerated zone by passing from a dissolved state in the water to a gaseous state in the surrounding bubbles. However, a significant amount of air will remain dissolved in the water until it is gradually released and equilibrium is reached further downstream. However, as the water flows downstream, the only interface available for release of the supersaturated gases is the river surface itself. Due to the surface to volume ratio of the Columbia River, off-gassing via this route can be a relatively slow process.

Aquatic organisms living in a river that is supersaturated will tend to come into a state of equilibrium with the level of dissolved gases that surround them. As long as the organism remains at an adequate depth, the gases will remain in solution due to the hydrostatic pressure exerted on it. However, as the organism ascends towards the surface, the dissolved gas will return to a gaseous phase as bubbles in the bloodstream and blisters in the tissue. The effect is similar to "the bends" that divers can experience if they ascend too quickly. In short, supersaturation caused by spills at dams results in uncompensated hyperbaric pressure in motile aquatic organisms. In fish, this condition is termed gas bubble trauma (GBT)

Dissolved gas affects all aquatic biota similarly, whether salmonids, resident fish, or invertebrates. The biological effect is a function of dose response as moderated by hydrostatic pressure, that is, depth. Each meter of depth equates to 10 percent of depth compensation. This means that the organisms' depth determines the biological effect of exposure to water supersaturated with atmospheric gas. If the COE's fixed monitoring station records a gas level of 120 percent supersaturation, it is referring to a gas level relative to water surface pressure. This same gas content at a depth of one meter equates to 110 percent supersaturated due to the compensatory influence of hydrostatic pressure.

At a depth of two meters, it is in equilibrium (i.e. no longer supersaturated). The same is true for fish or invertebrate tissue levels of gas.

Columbia River fishery biologists have learned a great deal with regard to aquatic organisms' responses to exposure to supersaturated gases and the onset of adverse effects associated with bubble formation. In the mid-1960s, the physiology of TDG and the thresholds for harmful effects were researched, resulting in the establishment of the 110 percent threshold TDG standard. However, the studies were performed in shallow laboratory troughs that did not provide opportunities for organisms to access deeper water that their normal behavioral might have led them to.

NMFS conducted an assessment of risk to juvenile and adult salmonids exposed to supersaturated gases generated through implementation of the voluntary spill program (NMFS 2000). The risk analysis was based on the results of the biological monitoring program conducted between 1995 and 1999. During these years, approximately 200,000 juvenile fish were sampled. It has been known for some time that GBT in juvenile salmonids can be visually observed in fish. Even at relatively low supersaturation levels of 110 percent, signs can develop if the exposure is long and the water is shallow. The onset of GBT and death of the organism is a function of the levels of TDG in the water and exposure duration.

Based on several years of data from the biological monitoring program, the average incidence of GBT signs in the Columbia River was relatively low. The accumulated data on GBT in juvenile Chinook salmon and steelhead revealed few GBT signs below 120 percent TDG. However, the prevalence of bubble-related injuries increased as TDG levels exceeded 120 percent and severe signs began to appear in monitored fish at levels of 130 percent or more.

The monitoring program for adult salmonids showed a similar relationship between the onset of signs of GBT and TDG as was seen in juveniles. Few adult fish displayed signs of GBT at TDG levels below 120 percent saturation. Investigators theorized that the lower levels of injuries that were observed in the adult fish may be attributable to the depths at which returning salmon migrate. Depth-sensitive radio tags used in adult migration studies confirmed that adults migrate at depths up to four meters (12 feet) where they are protected from GBT by hydrostatic pressure.

The fishery managers note that the Independent Scientific Advisory Board's evaluation of gas abatement (ISAB 1998) and NMFS's Opinion for the Federal Columbia River Power System (NMFS 2000) found that dissolved gas levels of 120 percent saturation were conservative and not harmful to salmon in the river. Further, analysis of three years of research from in-river juvenile salmon sampling in the Columbia River indicates that very low incidences of GBT were found in juvenile salmon that were exposed to dissolved gas levels up to 125 percent saturation (Backman et al. 2002, as cited in ACOE 2006). This included fish sampled during two high flow years where spills were often released at uncontrolled levels. Backman and Evans (2002, as cited in ACOE 2006) found that in samples of 4,667 adult Chinook salmon, fish were rarely observed with gas bubble trauma, despite sampling large numbers when TDG levels exceeded 130 percent saturation. Specifically, Backman and Evans (2002, as cited in ACOE 2006) found no statistically significant relation between total dissolved gas and gas bubble trauma for Chinook salmon. For adult sockeye and steelhead, Backman and Evans (2002, as cited in ACOE 2006) found that most GBT symptoms were minor (greater than 5 percent fin occlusion) with severe trauma (greater than 26 percent fin occlusion) being observed only when total dissolved gas exceeded 125 percent saturation.

In recent years more research has been conducted to evaluate the effects of spills on resident fish and invertebrates. Ryan et al. (2000, as cited in ACOE 2006) reported on four years of investigations during which resident fish and invertebrates were collected and inspected for signs of GBT. Nearly 40,000 specimens were analyzed in this study. The objectives of the study were to investigate the impacts of TDG supersaturation due to the spill program on the aquatic biota in the segment of the Columbia River below Bonneville Dam. The resident fish and invertebrates were collected from three sites: 1) above Priest Rapids Dam, 2) on the Snake River below Ice Harbor Dam, and 3) below Bonneville Dam in the area of concern. All of the fish sampled were collected in a depth range of 0 to 3 meters because any organisms that would have been collected below three meters of depth would have been protected from the effects of supersaturated gases by hydrostatic pressure. Benthic invertebrates were sampled to a depth of 0.6 meters. The field sampling was conducted from April through June of the years 1994 to 1997. Twenty-eight species of resident fish were collected at the three sampling sites. Results indicate that approximately 4 percent of the fish displayed signs of GBT, most appearing in 1996 and 1997 when involuntary spills were common and TDG levels were well above the limits. The results of this study are summarized in Table 15.

Table 15. Resident fish and invertebrates collected below Bonneville Dam, sampling year, total dissolved gas levels, number of fish collected and inspected and gas bubble disease signs recorded.

Year	**TDG Level Monitored**	**# of Fish Sampled**	**Gas Bubble Trauma Incidence**
1994	120 percent	4955	3 fish with signs
1995	Exceeded 120 percent four times, but less than 125 percent	1963	2 fish with signs
1996	Daily average peaked over 120 percent April to mid-May. Over 130 percent through end of June	1116	5.1 percent of specimens showed signs of GBT
1997	Above 125 percent for 10 weeks, and > 135 percent for 12 days	813	18.0 percent of specimens had GBT

Weitkamp et al. (2003a and 2003b, as cited in ACOE 2006) published results of two resident fish studies in 2003. Both investigations were conducted on resident fish species in the lower Clark Fork River in northern Idaho. The reports addressed the incidence and severity of GBT and fish behavior in supersaturated waters. In the former study, fish were captured with electro-shockers in the four years from 1997 to 2000. During several high water events in 1997, involuntary spills in the Clark Fork at Cabinet Gorge Dam resulted in gas levels approaching 150 percent. The spring runoff in 1999 was more moderate, but also resulted in TDG levels ranging from 120 percent to 130 percent. A total of 16 species of resident fish were captured during the investigations. The bulk of the species (84 percent) were large scale sucker, northern pike minnow, peamouth, and mountain whitefish (ACOE 2006). Resident salmonid species comprised the remainder of the list.

The Weitkamp et al. (2003b, as cited in ACOE 2006) study is a good indicator of resident fish GBT incidence and severity. After four years of investigation, the authors concluded that moderate levels of TDG did not have a substantial effect on resident fish in the lower Clark Fork River. Intermittent exposure to 120-130 percent saturation levels increased the likelihood and severity of adverse effects (harm). The key factor explaining these results is that the fish had access to deeper waters in the river habitat. It is also important to keep in mind that these are not controlled conditions and the fates of fish that were not captured are unknown.

In the second Weitkamp et al. investigation, pressure sensitive radio frequency tags were placed on several resident fish species, including brown trout, bull trout, west slope cutthroat, rainbow trout, mountain whitefish, large-scale sucker and northern pikeminnow. The tagged fish were tracked for periods up to 49 days during the spill season. All fish tended to remain at depths of two meters (6 feet) or deeper. The conclusion is that the normal behavior of these species puts them at depths that mitigate exposure to the TDG supersaturation levels as measured at the water surface.

However, dams occasionally exceed the 125 percent TDG limits (one hour average) during uncontrolled spills, increasing the likelihood of harm to juvenile and adult salmonids. Therefore, the EPA has determined that its approval of this provision is likely to adversely affect Columbia River spring run, Snake River fall run, and Snake River spring/summer run Chinook and Snake River, upper Columbia River and Middle Columbia River steelhead, and Snake River sockeye salmon. NMFS concurs with this determination.

Procedures for Applying Water Quality Standards. Ecology's water quality standards include the following provisions at WAC 173-201A-260(3):

> "(3) Procedures for applying water quality criteria**.** In applying the appropriate water quality criteria for a water body, the department will use the following procedure:
>
> > (b) Upstream actions must be conducted in manners that meet downstream waterbody criteria. Except where and to the extent described otherwise in this chapter, the criteria associated with the most upstream uses designated for a waterbody are to be applied to headwaters to protect nonfish aquatic species and the designated downstream uses.
> > (c) Where multiple criteria for the same water quality parameter are assigned to a water body to protect different uses, the most stringent criterion for each parameter will apply."

These provisions will ensure that Ecology's water quality standards are applied in a way that will be most protective of aquatic life. Part (b) of this section ensures that when a criterion is being applied in a specific action (e.g., in an NPDES permit or a TMDL) the effects of the action must analyzed in downstream waters to ensure that the downstream criteria will be met. For example, if fish spawning downstream is protected by 13° C, the effects of the action upstream must not degrade temperature and other standards to this downstream use.

Natural and Irreversible Human Conditions Provisions--Ecology's water quality standards include the following provision at WAC 173-201A-260(1):

> "(1) Natural and irreversible human conditions.
>
> (a) It is recognized that portions of many water bodies cannot meet the assigned criteria due to the natural conditions of the water body. When a water body does not meet its assigned criteria due to natural climatic or landscape attributes, the natural conditions constitute the water quality criteria."

Ecology's water quality standards define natural conditions as "…surface water quality that was present before any human-caused pollution. When estimating natural conditions in the headwaters of a disturbed watershed it may be necessary to use the less disturbed condition of neighboring or similar watershed as a reference condition." EPA views criteria based on natural conditions to be fully protective of salmonid uses, even if the natural conditions are higher than the numeric criteria for some water bodies, because the pollutant level prior to human impacts clearly supported healthy salmonid populations. According to the BE, if the natural conditions criteria would result in pollutant levels that cause adverse effects to salmonids, those adverse effects would be viewed as naturally occurring adverse effects.

The Temperature Guidance recommends that when estimating natural conditions (i.e. natural thermal potential) on a case-by-case basis in the context a TMDL, 303(d) listing, NPDES permit, or a 401 certification, the best available scientific information and techniques should be utilized. The Temperature Guidance provides guidance on what EPA considers are the best available methods to estimate the natural conditions for temperature. Ecology has described the methods it will use to determine natural conditions in its January 19, 2006 letter to EPA (Appendix F of the BE). The EPA believes the Ecology methods are consistent with those recommended in the Temperature Guidance.

When Ecology becomes aware of information documenting a violation of the numeric criterion, it will list the water body on the 303(d) list, unless the exceedance is due to natural conditions. If Washington does not have information that demonstrates the violation is due solely to natural causes, they will use the TMDL process to investigate whether the violation may be attributed to natural condition.

Under the CWA, EPA is required to approve or disapprove Ecology's TMDLs and 303(d) listing of impaired waters. For TMDLs where the applicable WQS is the natural condition criteria, the TMDL must document the methodology and resultant estimates of natural thermal potential. If the natural condition determination in the TMDL is inconsistent with Ecology's natural condition criteria, EPA has the authority to disapprove the TMDL because the TMDL would not be designed to attain Ecology's WQS. If Ecology relies on its natural condition criteria as a basis not to list a water body that exceeds the biologically-based criteria on the 303(d) list, it must document its basis for making such a determination and its basis must be consistent with its natural conditions criteria in order for EPA to approve the 303(d) list. Further, the subsequent CWA actions described above may also include an ESA consultation.

Under the CWA, EPA has oversight authority over the NPDES program. If a natural condition provision is being implemented through the permitting program, EPA can review the natural condition determination to ensure that it is consistent with the State's natural condition provision. The EPA does have the authority to object to state issued permits if they are inconsistent with the State's water quality standards and the NPDES regulation. If the State does not adequately address EPA's objection, EPA can federalize the permit (i.e., EPA would be responsible for writing and issuing the permit).

The EPA's approval of the natural conditions provision is likely to result in water quality levels in some waters that could lead to adverse effects on listed species, but those adverse effects would be naturally occurring, and could not be avoided or minimized without artificial measures to counteract the naturally occurring conditions.

This provision may affect all the listed species assessed in this Opinion, because it could be applied anywhere in the State. However, by definition, any adverse effects associated with this provision are natural and not attributable to the provision itself. Therefore EPA has concluded that its approval of this provision is not likely to adversely affect Chinook salmon ESUs (Upper Columbia River Spring Run, Lower Columbia River, Snake River fall Run, Snake River Spring/Summer Run, Puget Sound), Steelhead ESUs (Puget Sound, Snake River Basin, and Upper Columbia, Middle Columbia, and Lower Columbia River Basin), Columbia River chum salmon and Hood Canal summer run chum salmon, Lower Columbia River coho salmon, Snake River sockeye salmon, Ozette Lake sockeye salmon, Columbia River Basin bull trout and Coastal/Puget Sound bull trout. NMFS concurs with the EPA effect determination.

Another component of the Natural and Irreversible Human Conditions provision needing consideration is sub-paragraph ("b)." Sub-paragraph (b) states:

> (b) When a water body does not meet its assigned criteria due to human structural changes that cannot be effectively remedied (as determined consistent with the federal regulations at 40 CFR 131.10), then alternative estimates of the attainable water quality conditions, plus any further allowances for human effects specified in this chapter for when natural conditions exceed the criteria,

may be used to establish an alternative criteria for the water body (per WAC 173-201A-440).

The above provision comes into play when Ecology is petitioned for a "use attainability analysis. WAC 173-201A-440 describes Ecology's method for conducting a use attainability analysis or UAA. A UAA is a process for removing a designated use assigned to a water body. According to the WAC, it is a structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological, and economic factors. A "use" can only be removed through a UAA if it is not existing or attainable.

Anyone can submit a proposal to Ecology to conduct a UAA to remove a designated use (e.g., summer core spawning and rearing). The written proposal must include sufficient information to demonstrate that the use is neither existing nor attainable. The decision to approve a UAA is subject to a public process including intergovernmental coordination and Tribal consultation. The EPA must approve or disapprove Ecology's decision, based on the UAA process, to remove a designated use.

It is impossible to predict at this point what affect, if any, these chapters of the 2006 standards will have on listed species. Approval of the UAA process itself will have no affect on listed species. However results from a specific UAA may. Because each UAA is subject to an EPA approval action, NMFS's consideration of this part of the EPA action will be taken up on a case by case basis when future UAA approval actions are proposed by EPA during subsequent Section 7(a)(2) consultations.

Effects on Critical Habitat

NMFS designates critical habitat based on physical and biological features that are essential to the listed species. Essential features or primary constituent elements (PCEs) of designated critical habitat for salmon and steelhead include: (1) freshwater spawning sites; (2) freshwater rearing sites; (3) freshwater migration corridors; (4) estuarine areas; and (5) nearshore marine areas. The proposed action is relevant to the three freshwater PCEs in the list above. Within these three freshwater PCEs, substrate, water quality, water quantity, food, riparian vegetation, natural cover, floodplain connectivity and access, water velocity, space and safe passage are essential physical and biological features. These essential features are necessary to conserve the ESUs and DPSs and support viable salmonid populations. Among this list of essential features, only water quality is affected by the proposed action. This effect is largely the same for each ESU and DPS. The effect on water quality for each PCE is discussed below.

In most ESUs and DPSs in Washington (see Status of Species section above), water quality is listed among the limiting factors. In particular, water temperature is limiting. The proposed standards will help maintain good water quality in areas that are currently functioning properly. In some areas where temperature standards are becoming more stringent (13° C summer spawning and fry emergence standard, and assignment of 16° C summer core in place of old Class A designation), conditions could improve for critical habitat. But, because many areas will have no change to conditions for critical habitat, limiting factors relating to water quality will remain an impediment to salmonid recovery in these areas. The following summary of effects on PCEs mirrors the preceding analysis of water quality effects for the listed fish.

Freshwater Spawning Sites. Most spawning occurs at temperatures between 4° and 14° C, and the optimal incubation temperatures are between 4° and 13° C. The EPA's approval of the 2006 revised standards adequately protects this PCE both in areas that have the 13° C spawning criterion applied and in areas that naturally cool from the designated use standard prior to the on-set of spawning. Some areas are populated by adults holding prior to spawning. Adult holding and spawning may occur prior to the dates the 13° C criterion becomes affective for the year, or incubation continues beyond the date 13° C is applied. In these periods, the applicable standard is either 16° C or 17.5° C. In years when significant numbers of early returns begin spawning prior to the applicability of 13° C, there could be heightened risk that some embryos will be affected and possibly reducing the overall population potential for that given brood year.

Freshwater Rearing Sites. For any of the ESUs and DPSs, the abundance of juvenile salmonids in a given reach is directly influenced by the size of the population, success of that years' embryo survival, food availability, interactions with other species, including predators, and the quantity and quality of suitable habitat. Water quality is an essential element which defines suitable rearing habitat and affects juvenile abundance as much as any other factor. Juvenile salmonids can withstand slightly elevated temperatures after their emergence from the gravel. While elevated temperatures can heighten the risk for disease, warmer waters can accelerate growth when food is not limiting. For most freshwater rearing juvenile salmonids, temperatures below 16° C are the preferred temperature (Spence 1996, EPA 2003). The Ecology 2006 revised standards at the ESU and DPS scales will adequately support this PCE. There are localized exceptions however, these are discussed earlier in the Opinion (summarized in Tables 12, 13, and 14; and in the discussion on mixing zones, beginning on page 85).

Freshwater Migration Corridors. The proposed action would have varying affects on freshwater migration. It depends on the use designation, and the time of year the designation may apply. Freshwater migration is obviously important for juveniles and adults alike. However, the temperature sensitivities for these two life-history phases can be different depending on the behavioral need of the individual at any given time.

Adult Pacific salmon and steelhead may begin upriver migration at every month of the year in different rivers. Most adult salmonids typically migrate at temperatures less than 14° C; however, spring and summer Chinook salmon migrate during periods when temperatures are warmer. As salmonids migrate from marine waters, the fish cannot completely assess conditions in the river, so natural selection favors salmon migrating at the times that provide suitable amounts and quality of water for each river. These conditions, given the river's typical temperature and flow regime, will allow them to reach the spawning grounds with enough energy to spawn and allow their offspring to develop and emerge in time to feed, grow and emigrate. Excessively high or low temperatures may result in delays in migration (Spence et al. 1996, Groot and Margolis 1998).

Internal biological processes leading to complete sexual maturation in salmon begin many months before the fish reproduce in the species that typically have protracted residence in freshwater before spawning (i.e., some stocks of Chinook, sockeye, coho and steelhead). In addition to the long period of adult maturation, salmon have unusually protracted periods of embryonic development compared to most fishes (Norman and Greenwood 1975). Also, the spawning grounds may be many miles distant from the mouth of the river. Thus the two ends of the reproductive process – the initiation of gamete maturation and entry into freshwater to spawning – are greatly separated in time and often also in space (Quinn and Adams 1996). As a consequence of this temporal and spatial separation, water quality conditions experienced by adults from freshwater entry through migration to the spawning grounds may be directly connected to the developmental success of their offspring many months later.

Upriver migration to distant spawning grounds is energetically demanding and substantial levels of adult mortalities, prior to spawning, can occur. These pre-spawn mortalities are often associated with high temperatures which both weaken the fish and accelerate the proliferation of pathogens. Those fish may arrive on the spawning grounds with too little energy or die of infection along their migration to the spawning grounds.

The Ecology 2006 revised standards adequately protect adult migration and allow them to successfully complete their reproductive phase. However, earlier in this Opinion some exceptions were noted for specific watersheds (see Tables 12, 13 and 14) where the temperature criterion puts some adults at risk per the above discussion. In addition, the allowable TDG exceptions on the Columbia and Snake Rivers will increase risk to the Columbia River ESUs and DPSs including: The UCR spring Chinook; Snake River fall Chinook; Snake River spring/summer Chinook; Snake River steelhead; UCR steelhead; MCR steelhead; and Snake River sockeye.

Some stocks of juvenile salmon and steelhead are in freshwater virtually every month of the year in many rivers. Temperature affects migration timing, growth, smoltification, disease and degree of predation. Generally, the Ecology 2006 revised standards for temperature protect juvenile migration. Notable exceptions are those reaches that do not have the 16° C Core Summer Salmonid Habitat beneficial use designation, or the 13° C special spawning criteria. These areas are discussed earlier in this Opinion and summarized in Tables 12 and 14 and in the text following Table 14 on page 78. Some localized increased risk to juvenile migration PCE may result in these areas. It is unknown however, of the areas discussed in this Opinion not protected by the more stringent standards during summer maximum temperatures, how many "pockets" of naturally occurring cold water refugia may exist along the migration corridors that would reduce the risk to this PCE among the listed ESUs and DPSs.

Summary of Effects on Critical Habitat. In summary, Ecology's 2006 revised standards provide sufficient protection of the three freshwater PCEs by setting standards that meet the overall needs of the species at the ESU and DPS scales. These ESUs and DPSs include: Snake River fall Chinook, Snake River spring/summer Chinook, upper Columbia River spring Chinook, lower Columbia River Chinook, Puget Sound Chinook, Columbia River chum, Hood Canal summer chum, lower Columbia River coho, Snake River sockeye, Lake Ozette sockeye, Snake River steelhead, upper Columbia River steelhead, middle Columbia River steelhead, lower Columbia River steelhead and Puget Sound steelhead. As discussed above, the essential physical and biological feature affected is water quality, and the water quality parameters subject to this consultation generally maintain (except as noted) adequate existing conditions regarding those parameters for designated critical habitat; and in some cases, may return degraded conditions back to functional and productive habitat for listed salmon and steelhead.

Cumulative Effects

Cumulative effects are defined in 50 CFR 402.2 as those effects of future State, tribal, local, or private actions not involving Federal activities, on endangered or threatened species or critical habitat that are reasonably certain to occur in the action area considered in this Opinion. Examples of such actions include completed recovery plans, Habitat Conservation Plans, and ESA Limit 8 restoration projects. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Future anticipated non-Federal actions that may occur in or near surface waters in the State of Washington include timber harvest, grazing, mining, agriculture, urban development, municipal and industrial wastewater discharges, road building, sand and gravel operations, off-road vehicle use, fishing, hiking, and camping. These non-Federal actions are likely to continue having unquantifiable adverse effects on the endangered and threatened species addressed in this Opinion, and on their designated critical habitat. Each activity often has undesirable and often unanticipated deleterious affects on water quality. These include increases in sedimentation, loss of riparian shade (increasing temperatures), increased non-point runoff, decreased infiltration of rainwater (leading to decreases in shallow groundwater recharge, leading to decreases in hyporheic flow, leading to decreases in summer low flows), among others.

There are also non-Federal actions likely to occur in or near surface waters in the State of Washington that are likely to have beneficial effects on the endangered and threatened species. These include implementation of riparian improvement measures, fish habitat restoration actions, and best management practices (e.g., associated with timber harvest, grazing, agricultural activities, urban development, road building and abandonment, recreational activities, and other non-point source pollution controls).

One of the primary factors that affect stream temperature are non-point sources. Non-point sources that affect instream temperatures and DO concentrations include agriculture, forestry, and urban development. In the TMDLs that Ecology developed to meet existing temperature standards, increased effective shade is the primary non-point source control for reducing stream temperatures; the primary measure for non-point source control is riparian buffers. Thus, riparian buffers are also likely to be the primary means for non-point sources to comply with the temperature provisions of the proposed rule. Riparian buffers would reduce stream temperatures by increasing effective shade, improving thermal microclimates, reducing erosion and improving stream bank stability, increasing woody debris, and perhaps reducing channel width. A 100-foot buffer on either side of waters affected by the revised temperature criteria would be expected to eventually provide maximum effective shading while also providing microclimate and other benefits.

Approved TMDLs for DO in Washington indicate that the DO criteria can be achieved through reductions in stream temperatures, biochemical oxygen demand (BOD), and nutrient (e.g., nitrogen and phosphorus) loads. Riparian buffers not only provide shade and microclimate benefits, reducing stream temperatures, but also provide filtration and serve other functions that reduce nutrient loadings to water. Reduced loadings of nutrients and sediment (including organic matter) will result in reduced BOD, which will in turn lead to higher instream DO concentrations. Lower stream temperatures also contribute to higher DO levels, since oxygen is more soluble at lower water temperatures. Thus, for streams that were affected by the change in temperature criteria (i.e., waters that were upgraded from salmonid rearing and migration only to salmonid spawning, rearing, and migration), the effects of properly implementing an effective TMDL that includes establishment of a riparian buffer would be considered entirely beneficial.

Riparian buffers are already required in many instances. The Washington Forest Practices Act and associated rules, covered by an approved ESA conservation plan, contain an array of best management practices, including riparian buffer requirements, to protect water quality and achieve other environmental goals. As monitoring and adaptive management leads to possible changes in riparian buffers to protect stream temperatures, the revised WQS standards may result in stricter buffer requirements for the forestry sector, especially in headwater streams (char waters) and areas where salmon spawn during the late summer.

As for point sources, compliance with the 2006 WQS revision represents the baseline control scenario for non-point sources; only incremental controls and costs needed to achieve further reductions represent the affect of the proposed rule. However, water quality modeling would likely be needed to determine baseline temperatures after implementation of controls (including riparian buffers) needed to attain the 2006 revision. An upper-bound scenario of the extent of riparian buffers that may be needed is all land capable of supporting site-appropriate vegetation adjacent to affected waters (i.e., plantable); this scenario likely overstates acreage needed and costs for compliance with the proposed rule.

Based on GIS analysis of USGS land cover data, there are 39,300 acres of agricultural, urban, or other potentially plantable (not including forest lands) land within 100 feet of waters affected by the proposed rule. Ecology estimates that it would cost approximately $5.2 million annually to plant riparian buffers along the newly designated core summer salmonid habitat and char waters. The Farm Service Agency provides approximately $2.1 million for farmers and small landowners to plant riparian buffers under the

Washington Conservation Reserve Enhancement Program. Since the program began in 2000, over 600 miles of forest buffers have been planted along salmon-bearing streams in the state. Although progress is slow and costly, approving the revised temperature standards will provide a regulatory mechanism and level of assurance that the WQS must be met, which may ultimately result in reduced stream temperatures (through implementation of effective TMDLs).

The potential effect of the proposed rule on existing water rights is likely to be limited. State laws that protect instream water flows do not affect existing rights for water use. To enhance instream flows, the State can purchase existing water rights from willing owners. In these instances, the State bears the cost voluntarily (which implies that the benefits exceed the costs).

One of the likely cumulative effects on Pacific Salmon and their associated aquatic habitat throughout the state of Washington is ongoing and future climate change. Climate change has the potential to profoundly alter the aquatic habitat (Bisson et al. in press). These effects would be expected to be evident as alterations of water yield, peak flows, and stream temperature. Other effects, such as increased vulnerability to catastrophic wildfires, may occur as climate change alters the structure and distribution of forest and aquatic systems.

Climate change, and the related warming of global climate, has been well documented in the scientific literature (IPCC 2007; ISAB 2007; WWF 2003). Evidence includes increases in average air and ocean temperatures, widespread melting of snow and glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (IPCC 2007; Battin et al. 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

Observations consistent with a changing global climate have already been documented in changes of species ranges and in a wide array of environmental trends (ISAB 2007; Hari et al. 2006; Rieman et al. in press). In the northern hemisphere, ice cover durations over lakes and rivers have decreased by almost 20 days since the mid-1800's (WWF 2003). For many species, their ranges have shifted pole-ward and elevationally upward. For cold-water associated salmonids in mountainous regions, where upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in range, which in turn can lead to a population decline (Hari et al. 2006).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. According to model predictions, average temperatures in Washington State are likely to increase between 1.7°and 2.9° C (3.1°and 5.3° F) by 2040 (Casola et al. 2005). Warmer temperatures will lead to more precipitation falling as rain rather than snow. There is concern, as the snow pack diminishes, and seasonal hydrology shifts to more frequent early large storms, stream flow timing will change and peak river flows will likely increase. Higher ambient air temperatures will likely cause water temperatures to rise (ISAB 2007). Data taken from stream gauges in western Washington over the past 5 to 25 years indicate a marked increasing trend in temperatures in most major rivers.

Pacific salmon rely on colder water for spawning and incubation, and increasing air temperatures are likely to adversely affect the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature and has been shown to strongly influence the distribution of Pacific salmon species. Ground water temperature can also be linked to selection of spawning sites and has been shown to influence the survival of embryos and early juvenile rearing (Spence et al. 1996, McCullough 1999). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Climate change is apparently already affecting the frequency and magnitude of fires, especially in the warmer, drier regions of the west. To further complicate our understanding of these effects, the forest type that naturally occurs in a particular region may or may not be the forest that will be responding to the fire regimes of an altered climate (Bisson et al. in press). In several studies related to the effect of large fires on fish populations, Pacific salmon and steelhead appear to have adapted to past fire disturbances through mechanisms such as spatial dispersal and genetic plasticity. However extreme fire events may have substantially changed watershed conditions for salmon and steelhead and other aquatic species, e.g., habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. in press).

Pacific salmonids can be found in lakes, large rivers and marine waters. Effects of climate change on lakes inhabited by migratory sockeye may change availability of prey and access to tributaries. Climate warming impacts to lakes may lead to longer periods of thermal stratification, with coldwater fish such as Pacific salmonids perhaps restricted to these bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the bottom layers and intensify competition for food (WWF 2003).

Pacific salmonids require cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, expected effects on hydrology associated with climate change are related to shifts in timing, magnitude and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007). The increased magnitude of winter peak flows in high elevation areas is likely to adversely affect spawning and incubation locations, period, and success for salmonids. Lower elevation rivers are not expected to experience as severe an affect from alterations in stream hydrology.

As climate change progresses and stream temperatures warm, thermal refugia will be essential to persistence of many salmonid populations. Thermal refugia are important for providing Pacific salmon and steelhead with patches of suitable habitat while allowing them to undertake migrations through or to make foraging forays into areas with greater than optimal temperatures. Juvenile rearing may occur in waters at or above the summer maximum temperatures in the WQS, but when it does, such rearing is usually found only in the confluence of colder tributaries or other areas of cold water refugia (EPA 2003). The Temperature Guidance recommends the protection and restoration of these important areas of cold water.

There is still a great deal of uncertainty associated with likely changes in timing, location and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007). However, several studies have revealed that climate change has the potential to affect ecosystems in nearly all tributaries throughout the state (ISAB 2007, Battin et al. 2007; Rieman et al. in press). In streams and rivers with temperatures approaching or already at the upper limit of allowable water temperatures, the likelihood salmonids will be able to adapt to, or avoid the effects of climate change is uncertain. In sum, climate change is likely to be an important factor, acting in concert with WQS, affecting distribution of salmonids in Washington State.

According to model predictions, average temperatures in Washington state are likely to increase between 1.7° and 2.9° C (3.1°and 5.3° F) by 2040 (Casola et al. 2005). Should these changes in temperature occur, Ecology may have to respond by addressing each river affected through the TMDL process.

Integration and Synthesis

Implementation and attainment of water quality standards are vital to improving Washington's water quality. NMFS participated in the development of the Temperature Guidance and worked closely with EPA, Ecology, and the Tribes in the development and refinement of the proposed water quality standards to see whether the criteria, beneficial uses, and narrative provisions meet the biological requirements of the ESA-listed salmonids covered by this consultation. As described above, adverse effects may occur from approval and subsequent implementation of the proposed water quality standards.

Effects of EPA's approval of Ecology's revised water quality standards for temperature, DO, and antidegradation implementation include:

(1) During the brief period of maximum summer temperatures, possible localized elevation of disease risk for adult and juvenile salmon and steelhead, reduced viability of gametes in some holding adults, and reduced growth of some juvenile salmon and steelhead due to possible under-designation of the 16° C criterion (summer core spawning and rearing) and over-designation of the 17.5° C criterion. However, NMFS has determined that overall:

- The effects of the proposed action are broadly expected to be beneficial to individual salmon and trout and to the primary constituent elements of their critical habitat that address water quality in all areas where the standards are adequate to protect the life history stages of these listed fish. The proposed action may adversely affect some adult salmon and the primary constituent elements of critical habitat that address water quality during the summer in migratory corridors that were not designated as "core summer salmonid habitat."

- It is significant that implementation of and compliance with the revised standards are likely to improve water quality (i.e., provide cooler temperatures) in most all of the streams statewide that currently support listed salmon and trout, especially in areas that are used for reproduction and juvenile-rearing during warmer months of the year. All identified salmon and trout summer spawning areas in Washington will be adequately protected by the 13° C special spawning criteria.

- The proposed action will also result in a reduction of stream temperatures by several degrees in all areas that were formerly Class A or AA and are now designated as "core summer salmonid habitat" (approximately 30 percent of the water bodies in the State) with seasonal application of the salmon spawning temperature criterion (13° C late summer through late spring). The temperature standards were also lowered by several degrees in areas that were formerly Class B and are now designated as "salmonid migration and rearing" areas (approximately 5 percent of the water bodies).

- Application of the 17.5° C temperature criterion in some portions of the lower rivers (Snohomish, Stillaguamish, White, and Puyallup) is not likely to preclude the passage function of these migratory corridors. Current summer maximum temperatures already exceed 17.5° C in most areas and the proposed standard generally reflects the natural thermal potential of rivers in the Pacific Northwest. Application of the 13 and 16° C temperature criteria is likely to provide additional cooling upstream of the agricultural and urban areas and implementation of the antidegredation policy is likely to protect water bodies with temperatures that are colder than the standard. Although individual salmon and trout may be present year-round in the lower reaches of rivers, most of the use of the lower rivers occurs in the winter and spring when water temperatures are lowest and when adult and juvenile salmon and trout are moving out of or into the marine environment.

(2) The baseline condition will remain unchanged in areas where the current temperature standards are retained. The Yakima, Columbia, Walla Walla, Pend Oreille, and Snake rivers have special temperature provisions that allow temperatures of 20 and 21° C. Although these water bodies are designated as "salmonid migration and rearing," the 17.5° C temperature standard that is necessary to protect the existing use was not applied, effectively making the special provisions the standard for these areas;

- Degraded baseline conditions in the Yakima and Walla Walla rivers with the "special temperature" criteria remaining unchanged, and therefore unsupportive of designated uses, is of concern to NMFS. Middle Columbia River steelhead are threatened in these rivers. NMFS believes it is important that EPA strongly support Ecology (as soon as possible) in making necessary temperature adjustments to these areas that could support recovery of middle Columbia River steelhead. Reducing the frequency, extent, and duration of the thermal barrier (caused by the special temperature provisions) will appreciably improve passage and the likelihood of maintaining and restoring persistent populations of middle Columbia River steelhead where the special temperature provisions represent the standard.

(3) In cases where the water body's temperature is warmer than the criteria, localized elevation of disease risk for some adult and juvenile salmon and steelhead, and reduced growth of some juvenile salmon and steelhead, due to the cumulative allowance of an additional 0.3° C warming for human use is possible;

(4) The effects of the proposed action relative to the DO standard, which was changed in salmon and trout spawning reaches where the temperature standards were also changed, will only occur at least through 2009 or 2010. The magnitude and consequences of those effects on salmon and trout and their critical habitat are summarized below:

- Although the DO criterion was increased from 8 mg/L to 9.5 mg/L in these areas, the higher standard is not adequate to ensure successful embryo development and fry emergence salmon and trout spawning areas. Based on the physical factors that affect oxygen levels, the cross-over or threshold temperature where the DO standard will become limiting and result in adverse effects to salmon and trout is around 10° C. NMFS estimates that at temperatures below 10° C, the 9.5 mg/L DO standard will provide less protection than the natural condition, resulting in increased mortality of developing embryos and fry;

- Localized reduction in growth and survival of some listed salmon and steelhead embryos and alevins are possible due to insufficient IGDO resulting from a DO standard that has been set too low;

- Adverse effects related to the DO standard are likely occurring in many salmon and trout spawning areas in the State, not just the areas where the standards were changed. However, because the DO criterion was only changed in a few areas, we limited our analysis and extent of adverse effects associated with approval of this standard only to the affected spawning reaches. Applying a DO criterion that would allow oxygen levels to drop below 8 mg/L in the gravels within these areas will not provide adequate protection for salmon and trout reproduction and could affect VSP parameters of local populations. However, based on a review of Ecology's permitted facilities, it does not appear that there are any current point sources or permitted facilities that will affect oxygen levels in the spawning areas affected. Therefore, from the date of this analysis, to when anticipated changes in the Ecology DO standards will occur, we expect the risk to salmon and trout in spawning and rearing areas from point source permits to be very low;

- Due to the fact that naturally cold temperatures will ensure adequate DO levels in the areas and at the time of year when salmon and trout are spawning, as well as the limited scope and duration of the action (2007 to 2009), approval of the interim DO standard in some salmon and trout spawning areas is not expected to cause a measurable decline in populations in the affected areas. Ecology will revise the DO standard in all salmonid spawning areas if it is determined that the 9.5 mg/L criterion is inadequate to ensure the 8 mg/L minimum needed in the gravel for successful embryo development and fry emergence. Consultation on this matter will be reinitiated when EPA approves the final DO criterion for the entire state.

Conclusion

In summary, NMFS has reached the following conclusions:

1. The various temperature criterion and provisions that EPA is proposing to approve, in combination, provide adequate protection for listed salmon and steelhead in Washington.
2. Approval of the WQS should result in long term improvements in baseline conditions in areas where the revised standards became more stringent. Baseline conditions will remain in their current condition in areas where the standards did not change.
3. Approval of the DO criteria in specific areas will not result in a measurable change in the baseline condition. The WDOE is currently conducting a study to determine if the 9.5 mg/L DO criteria provides adequate protection for egg incubation and embryo development. Based on the results of the study, the DO standard may need to be revised in all water bodies that support spawning and rearing.
4. Application of the "Core summer salmonid habitat" designation (year-round 16° C temperature criterion and 13 ° C temperature criterion during spawning and incubation) will ensure cold water protection that will sufficiently support these uses.
5. Application of the 17.5 ° C temperature criterion is not expected to appreciably reduce salmon and steelhead survival or recovery for the following reasons:
    a. The criterion applies during the hottest time of year and must be met at the furthest downstream extent of the use, which significantly reduces the extent and duration where this standard is applied.
    b. This temperature criterion applies during the time of year and in areas where most salmon and steelhead use is seasonal and generally reflects the natural thermal pattern.
    c. Approval of this temperature criterion will not result in a measurable degradation of the baseline conditions.
    d. Since temperatures in most of the lower rivers exceed the standard, baseline conditions should gradually improve as TMDLs are implemented.

e. The antidegradation policy will provide protection for waters that are currently meeting or are colder than the standard.

f. The summer salmon spawning temperature criterion will provide additional thermal protection in the upper reaches of migratory corridors that were not designated as "Core summer salmonid" use.

After reviewing the best available scientific and commercial information available regarding the current status of the listed ESUs and DPSs covered in this Opinion, the baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that EPA's proposed approval of revised Washington water quality standards for temperature, DO, and antidegradation implementation methods is not likely to jeopardize the continued existence of the ESUs and DPSs covered in this Opinion.

The ESUs include Snake River fall run Chinook, Snake River spring/summer run Chinook, upper Columbia River spring run Chinook, lower Columbia River Chinook, Puget Sound Chinook, Columbia River chum, Hood Canal summer run chum, lower Columbia River coho, Snake River sockeye, Ozette Lake sockeye. The DPSs include Snake River steelhead, upper Columbia River steelhead, middle Columbia River steelhead, lower Columbia River steelhead, and Puget Sound steelhead.

NMFS concludes that the proposed action is not likely to destroy or adversely modify designated critical habitat of the ESUs and DPSs covered in this Opinion. The ESUs include Snake River fall run Chinook, Snake River spring/summer run Chinook, upper Columbia River spring run Chinook, lower Columbia River Chinook, Puget Sound Chinook, Columbia River chum, Hood Canal summer run chum, lower Columbia River coho, Snake River sockeye, Ozette Lake sockeye. The DPSs include Snake River steelhead, upper Columbia River steelhead, middle Columbia River steelhead, lower Columbia River steelhead, and Puget Sound steelhead. Our conclusion is based on the analysis of effects described in this Opinion.

<u>Reinitiation of Consultation</u>

To the extent EPA retains discretionary involvement or control over this action as described in 50 CFR 402.16, EPA must reinitiate consultation if: (1) the action is modified in a way that causes an effect on the listed species that was not previously considered in this Opinion; (2) new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered; (3) a new species is listed or critical habitat is designated that may be affected by the action; or (4) if the amount or extent of incidental take is exceeded.

In addition, using the process described in the EPA conservation measure pertaining to the Triennial Review of the Washington water quality standards, NMFS will assess whether reinitiation is appropriate based on the following:

1. Where the water quality standards allow discretion, whether the effects on listed species and critical habitat are consistent with those described in this Opinion;

2. Whether EPA has provided the information described in its conservation measures in a timely manner; and

3. Whether the results from the Ecology DO study warrant changes to the DO standards to protect designated uses.

Ecology's exercise of its discretion may result in additional affects to listed species and critical habitat that are not consistent with those described in this Opinion. NMFS may consider this circumstance to be a modification of the action that causes an effect on listed species not previously considered, potentially resulting in the need to reinitiate consultation. In addition, any subsequent CWA approval by EPA of a modified standard adopted by Ecology would constitute a new Federal action requiring ESA section 7 consultation.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NMFS recommends the following additional actions to promote the recovery of federally listed species and their habitats:

1. Several sections of the Ecology water quality standards (as discussed on pages 178 and 179 of the BE) were not changed and therefore were not part of EPA's proposed action. The EPA should recommend to Ecology to make necessary changes to the remaining standards to improve water quality conditions and the PCEs for listed fish and their designated critical habitat. NMFS is willing to work with EPA to identify specific sections of the standards and help with their revision.

2. The EPA should encourage Ecology to begin the process to designate high quality water as an outstanding resource water, and designate as either Tier III(A) which prohibits any and all future degradation, or Tier III(B) which allows for de minimis (below measurable amounts) degradation from well controlled activities. To begin with, Tier III designations should apply to those water bodies currently meeting or exceeding the current criteria (e.g., those listed at the bottom of Table 5 in the Environmental Baseline discussion of this Opinion).

3. Ecology did not revise the special temperature criteria for several rivers in eastern Washington, resulting in water bodies (that were designated as "salmon spawning, rearing, and migration," or "salmon rearing and migration" under the proposed action) retaining temperature standards that are well above 17.5° C and not

protective of the designated use. The Yakima River is a primary example where the current temperature standard does not protect the existing use, causes adverse effects to salmon and steelhead, and precludes critical habitat from meeting its intended recovery function. Per the Ecology January 2008 letter to EPA, the EPA should ensure that within 5 years, Ecology work with EPA and the Services to address the special temperature provisions to ensure that aquatic life uses are protected, or demonstrate that the natural condition of these river segments are equal to or exceed the special temperature criteria.

Incidental Take Statement

The ESA at section 9 (16 U.S.C. § 1538) prohibits take of endangered species. The prohibition of take is extended to threatened anadromous salmonid fishes by a section 4(d) rule. *See* 50 CFR 223.203. "Take" is defined by the statute as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 U.S.C. § 1532(19). "Harm" is defined by regulation as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavior patters, including: breeding, spawning, rearing, migrating, feeding or sheltering". 50 CFR 222.102. "Harass" is defined as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." 50 CFR 17.3. "Incidental take" is defined as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant." 50 CFR 402.02. The ESA at section 7(o)(2) removes the take prohibition from any incidental taking that is in compliance with the terms and conditions specified in a section 7(b)(4) incidental take statement. 16 U.S.C. § 1536.

<u>Amount or Extent of Take</u>

Incidental take of listed salmon and steelhead due to effects of temperature and DO is reasonably likely to occur in Washington under the proposed standards. Take from the standards may be in the form of any of the following: (1) localized reduction in growth and survival of some listed salmon and steelhead embryos and alevins due to DO criteria insufficient to provide adequate IGDO; (2) inadvertent miscalculations in water temperature criteria and application of use designations notwithstanding use of the best data currently available that in certain times and places would be likely to harm listed salmon and steelhead through impairment of behavioral patterns, including adult holding, spawning, rearing and migration; (3) a human use allowance that could allow warming of temperature impaired water bodies prior to a TMDL being completed, implemented, and for which goals have not been achieved; (4) water quality standards that could lead to sublethal physiological effects, heightened risk of disease for adults and juveniles, impaired spawning, and delay or blockage of migration within a portion of temperature mixing zones; (5) water bodies that currently exceed proposed standards could be allowed to become degraded to the proposed standards which could affect certain VSP parameters by delaying migration and other behavioral patterns; and (6) spills at dams that result in total dissolved gas levels that are harmful to fish.

Given the broad nature and scope of the proposed action, the best scientific and commercial data available are not sufficient to enable NMFS to estimate a specific amount of incidental take associated with the proposed action. As explained in the effects analysis above, NMFS has determined that the extent of take that is reasonably certain to occur is below the level that would be likely to jeopardize the listed species that are affected by this action. Indeed, substantial baseline improvements are expected by implementing the proposed action, in particular, protecting summer spawning and incubation (where these areas have been documented) with the more stringent 13° C temperature standard.

NMFS has worked extensively with EPA, Ecology, and Tribes in Washington during the development of the revised standards and believes that implementing the proposed standards will result in improved and functional water quality in many areas that support threatened and endangered Pacific salmon. NMFS acknowledges that the process of Rule making is arduous and expensive and recognizes that water quality revisions are an on-going process required by Triennial Reviews. NMFS looks forward to the opportunities in the near future to update and further refine the standards for the benefit of listed fish. NMFS authorizes the incidental take of listed species of salmon and steelhead resulting from the proposed action that are likely to occur from: (1) adverse effects from not applying the summer spawning and incubation standard of 13° C in all areas where spawning and incubation is presumed to occur; (2) protecting most, but not all rearing areas with a "core summer salmonid habitat" designation; and (3) applying a water column DO standard that is unlikely to meet minimum IGDO requirements of incubating eggs. Incidental take that is caused by other water quality parameters outside the scope of this consultation is not covered by this incidental take statement.

There may be future ESA section 7 consultations on particular EPA approvals of actions implementing the water quality standards covered by this Opinion. Incidental take from these activities would be analyzed and covered in those separate consultations. Where there is no Federal nexus for consultation, local entities may wish to seek incidental take coverage for activities (such as issuance of NPDES permits not associated with Federal or Tribal point-source discharges, stormwater management plans, etc.) through other ESA mechanisms, including section 4(d) limits or section 10(a)(1)(B) incidental take permits.

The EPA's approval of the freshwater aquatic life use designations and associated temperature and DO standards are the focus of this incidental take statement. Because functional water quality is vital to ensuring the long-term survival and recovery of Pacific salmon, NMFS must ensure water quality standards that adequately protect the existing uses and allow for expansion of water uses to reach recovery goals. The preceding analysis indicates that protecting cold water temperatures, especially in spawning and rearing areas, is essential to ensure the survival and recovery of listed Pacific salmon. It is NMFS' understanding that Ecology has the authority to make minor revisions to the standards, as needed, in order to protect existing aquatic life uses without having to go through rule making. Although WDFW and Tribal databases were useful in identifying general fish distribution and uses (spawning, rearing, and migration) across the state, these databases were not intended to be used to set regulations. The databases showed fish presence only where resource managers and biologists did field surveys. Typically biologists go back to the same areas year after year (so-called index areas) to count the spawners and redds to understand the strength of the returning run and make extrapolations for future population strengths or weaknesses. Only specific segments of creeks, streams, and rivers are observed. These segments are then sometime used to extrapolate to other areas within the watershed. Also, in many cases, rivers are too turbid, e.g., colored by glacial till or tannins, to ascertain salmonid use. In each of these circumstances, EPA chose not to include them in suggested changes. For example, WDFW has categorized spawning areas as follows: known, presumed, and potential. In many cases, EPA suggested, and Ecology adopted protective standards for only the known or confirmed spawning grounds. The Tribes and WDFW are responsible for identifying fish use and maintaining the database. It is imperative that WDFW provide updates to Ecology in a timely manner. In addition, adult holding areas are not typically identified nor included in any database. When adult fishes are crowded in warmer waters, they are susceptible to disease, and gamete development can be impaired. To maintain VSP parameters for each population, (i.e., abundance, productivity, spatial structure and diversity) it is vitally important that the adults have adequate cold water protections for holding that accommodates the entire returning stock, in addition to ensuring that all spawning areas are thermally protected. As new information becomes available on freshwater fish uses, it is NMFS's expectation that Ecology will revise the standards as soon as possible to protect these identified uses.

Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of listed salmon and steelhead:

1. Minimize the likelihood of incidental take resulting from EPA's approval of Ecology's water quality standards.

2. Ensure effectiveness of the conservation measures.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the EPA must comply with the following terms and conditions, which implement the reasonable and prudent measures stated above. These terms and conditions are non-discretionary. Where there are questions over technical definitions or interpretations (e.g., adverse effects, pockets of cold water) NMFS will work with EPA to achieve resolution.

EPA will utilize its CWA authorities as necessary to ensure that the below terms and conditions are met. Generally, it is expected that EPA will ensure that Ecology implements these items through EPA's general coordination and oversight of the Ecology water program.

1. To implement reasonable and prudent measure number one above, EPA shall:
   a. To protect existing and newly documented aquatic life uses, EPA shall ensure that Ecology makes timely updates to the standards, as needed in order to protect those aquatic life uses. EPA shall ensure that Ecology establishes, within a year from the date of this Opinion, a process to review new fish use data to evaluate if changes to the aquatic life designations or application of the spawning criteria are needed. The process shall include establishing a protocol with WDFW and the tribes to obtain current data on salmonid spawning, rearing, and migration. The process shall include an annual Ecology review of any new fish use information (e.g., changes in WDFW's GIS Fish Distribution Database). To protect existing and newly documented aquatic life uses, the EPA shall ensure that necessary revisions to the standards at issue in this consultation are adopted as part of the triennial review process, which generally means that changes in the standards would occur within approximately three years of when new information on fish use is documented. The following will be applied in the review process:
      i. If new salmon and steelhead spawning areas are documented as "known spawning," and if the spawning or incubation timing triggers the "Core summer salmonid habitat use" or application of the 13° C spawning criteria, then the designated use for the river segments shall be revised and/or the 13° C applied accordingly.
      ii. As the ecological importance to salmonids of a reach is learned (e.g., important adult holding, spawning and incubation, or juvenile rearing), Ecology shall review the existing use designation and shall make appropriate changes to the designated use to protect these important areas; and, make the necessary changes to the temperature standards to protect the new use designation.
   b. WAC 173-201A-310(1) reads: "Existing and designated uses must be maintained and protected. No degradation may be allowed that would interfere with, or become injurious to, existing or designated uses, except as provided for in this chapter." As Ecology's process (discussed in term and condition number one above) begins to identify areas of existing aquatic life uses that are not correctly designated or protected in the standards, EPA shall ensure that Ecology uses this information to apply its applicable antidegradation policy (e.g., using Tier I or Tier II) in any regulatory actions (e.g., NPDES permit, 401 certification, review of state non-point regulations) that may adversely effect these existing uses. This will provide interim protection until the standards are revised after formal rulemaking.

c. EPA shall ensure that Ecology fully implement its water quality policies and procedures described in the BE and in this Opinion to maximally protect areas with existing cold water.

   i. Rivers currently at or below their designated temperature criteria (e.g., those identified in Table 5) shall be protected using Ecology's Tier II antidegradation policy.

   ii. Rivers currently at or above their designated temperature criteria, but which have pockets of cooler water that meet or only slightly exceed the criteria, shall be protected using Ecology's Tier I antidegradation policy.

   iii. For a water body that is designated "Salmonid spawning, rearing, and migration use" with the applicable temperature criterion (i.e., 17.5° C, 20° C, or 21° C), and where a TMDL, or similar analysis, has been conducted that demonstrates the natural thermal potential of the water body is 16° C or below, the use designation shall be changed to the more appropriate "Core summer salmonid habitat use" as part of the process described in terms and condition number one above.

d. When Ecology issues NPDES permits for sources with heat discharges, EPA shall ensure that the aquatic life designated uses are protected. EPA shall ensure that Ecology implement the following measures to reduce impacts from thermal plumes where applicable.

   i. Prevent or minimize the potential exposure to salmonids from temperatures exceeding the 13° C spawning criterion in spawning, incubation and rearing areas;

   ii. Minimize the risk of acute impairment or instantaneous lethality by ensuring the temperature is less than 32° C after 2 seconds of plume travel and by preventing or limiting the potential for fish to be exposed to temperatures above 30° C within the mixing zone.

e. Prevent or minimize the risk of thermal shock to salmonids by restricting the area of the mixing zone, where temperatures could reach or exceed 25 ° C, to less than five percent of the 7Q10 flow of the water body; and

f. Prevent or minimize the potential for temperatures that could block or delay migration by restricting the area of the mixing zone where temperatures reach 21.0° C (or more) to less than 25 percent of the cross section of the 7Q10 low flow of the water body.

2. To implement reasonable and prudent measure 2, the EPA shall

    a. EPA shall review the results of the Ecology DO/IGDO study in collaboration with NMFS to determine whether changes to the DO standards to protect designated uses are warranted. The water column DO criterion must maintain an IGDO minimum of 8 mg/L for the duration of the spawning, incubation and fry emergence periods, unless this concentration is unattainable due to atmospheric and temperature conditions.

    b. If the Ecology study warrants changes to the DO standard to provide sufficient IGDO levels, EPA shall work closely with Ecology to make the necessary changes to the standards upon completion of the Ecology study.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Background

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA):

- NMFS must provide conservation recommendations for any Federal or state action that would adversely affect essential fish habitat (EFH) per Section 305(b)(4)(A) of the MSA.

- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must 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 NMFS' EFH conservation recommendations, the Federal agency must explain it reasons for not following the recommendations (Section 305(b)(4)(B)).

Essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA Section 3). For the purpose of interpreting this definition of EFH: "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 managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). "Adverse effect" means any impact which reduce quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Essential fish habitat consultation with NMFS is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects on EFH.

Identification of Essential Fish Habitat

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally managed Pacific salmon: Chinook (*O. tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). 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 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA Section 3). For the purpose of interpreting this definition of EFH: "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 manage species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.110). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Detailed descriptions and identifications of EFH are contained in the fishery management plans for groundfish (PFMC 1999), coastal pelagic species (PFMC 1998a), and Pacific salmon (PFMC 1998b).

Proposed Action

The proposed action is detailed above. For this consultation, NMFS defines the action area as all basins in Washington with anadromous fish use or designated critical habitat, including the Columbia River from mouth to the Canadian boarder (and all tributaries within Washington), the Snake River to the Idaho boarder (and all tributaries within Washington), Washington coastal basins, and Puget Sound and Hood Canal basins. This area has been designated as EFH for various life stages of Chinook, pink and coho salmon.

Effects of Proposed Action

Implementation and attainment of water quality standards are critical to improving Washington's water quality. NMFS participated in the development of the Temperature Guidance and worked closely with EPA, the State, and Tribes in the development of Washington's revised rules, to ensure that the criteria, beneficial uses and narrative provisions meet the biological requirements of Pacific salmon. As Washington completes TMDLs designed to meet the standards, issues or reissues permits in conjunction with those TMDLs, and incorporates non-point source controls adequate to meet water quality standards, the condition of impaired waters is likely to improve to the point of providing functional conditions for listed salmonids. However, as discussed in this Opinion, some short-term, localized adverse effects may occur from approval and subsequent implementation of Ecology's water quality standards.

The proposed action will adversely affect habitat for Chinook, pink and coho salmon due to: (1) Localized reduction in growth and survival of some Chinook, pink and coho embryos and alevins due to approval of a DO standard that may not be adequate to provide sufficient IGDO to these life history stages; (2) Possible localized, short-term adverse effects from inadequate temperature protections for holding adults and outwardly migrating juveniles by elevating disease risk in some Chinook, pink and coho salmon and by reducing viability of gametes in the holding adults; (3) possible localized, short-term adverse effects including delayed migration, sublethal physiological effects, and increased susceptibility to predation in some adult and juvenile Chinook, pink and coho salmon when approaching some mixing zones.

Conclusion

The proposed action is likely to lead to improvements in water quality for temperature, but in some localized places, and at certain times the action will adversely affect EFH for Chinook, pink, and coho salmon.

Essential Fish Habitat Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, 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, and all of the reasonable and prudent measures and terms and conditions listed in this Opinion above are applicable. In addition, NMFS recommends EPA review the designated use in the Hanford Reach on the Columbia River and reassign the use to protect Chinook salmon EFH.

Statutory Response Requirement

Note that the MSA (section 305(b) and 50 CFR 600.920G) 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 effects 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.

Supplement Consultation

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

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this document are the EPA, Ecology, WDFW, FWS, the Tribes, and NMFS, as well as the general public.

Individual copies were provided to the above-listed entities. This consultation will be posted on the NMFS NWR web site (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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